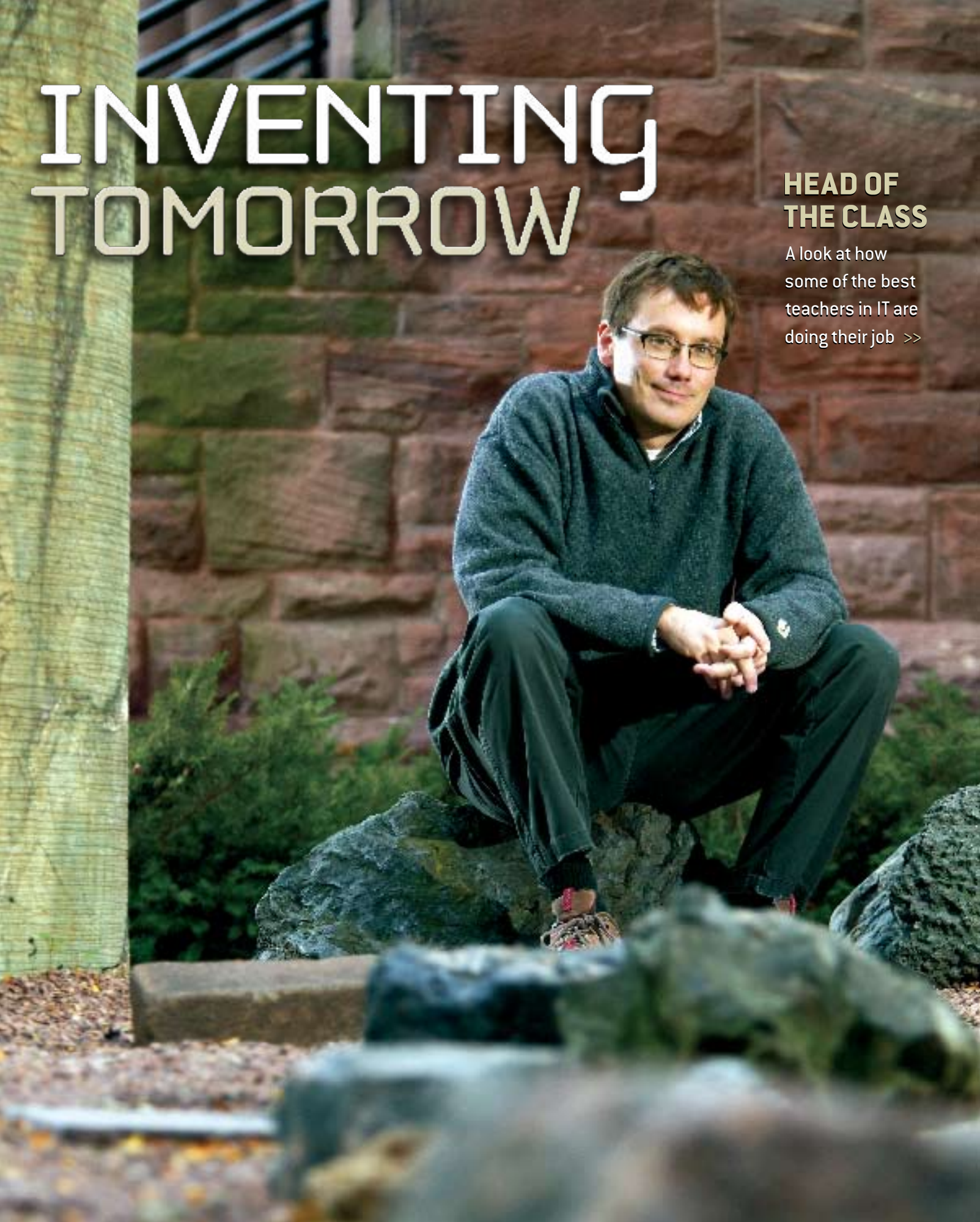

INVENTING TOMORROW

HEAD OF THE CLASS

A look at how some of the best teachers in IT are doing their job >>

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UNIVERSITY OF MINNESOTA

INVENTING TOMORROW
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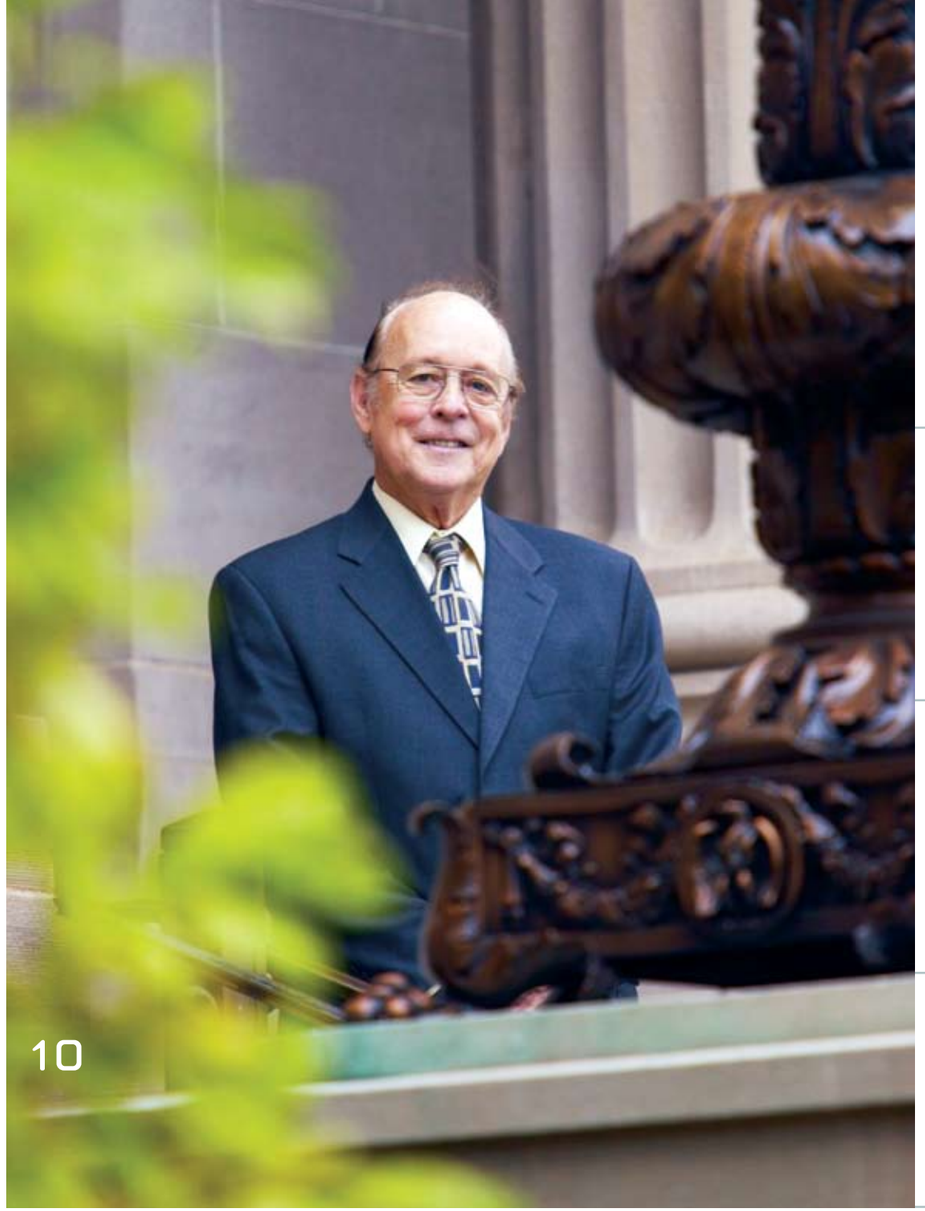


winter 2005
INVENTING TOMORROW

DEPARTMENTS

ON THE COVER

Assistant professor David Fox infuses his geology lectures with humor and creative analogies

PHOTO BY JONATHAN CHAPMAN

Snapshots from our journey together

Along the way I've met extraordinary people, traveled across the country and around the globe, and discovered a world of new ideas.

TIME FLIES WHEN YOU'RE HAVING FUN. The old adage is as true in academia as it is on the playground, and it explains—in part, at least—why the nine years I spent as dean passed so quickly.

I wasn't always so sure that would be the case. When I accepted the post in 1995, dwindling state support for higher education was forcing difficult choices and deep budget cuts across the University, as it would repeatedly throughout the next decade.

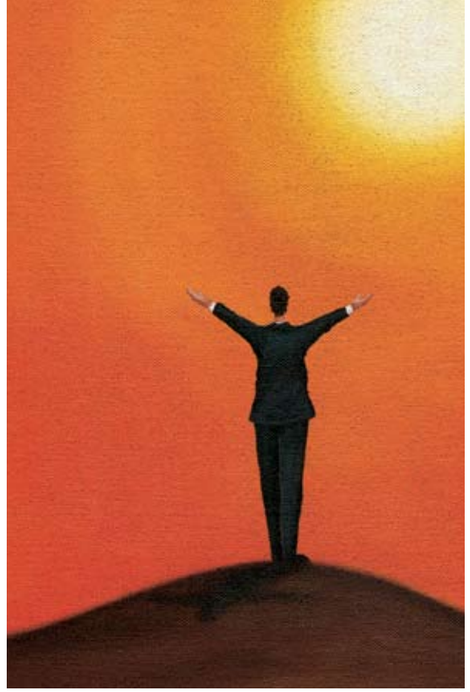
The challenges were daunting, but I didn't face them alone. Buoyed by the enthusiasm and ingenuity of our faculty, alumni, and friends, IT adapted to new fiscal realities and launched a series of strategic initiatives designed to keep our programs among the nation's best. I'm proud of all that we accomplished together.

Through successful efforts at the legislature we secured 36 new faculty positions, "right-sizing" the long-understaffed Department of Computer Science and Engineering and adding new expertise across the college through the University's digital technology and freshman seminar initiatives.

I worked with department heads to make key strategic hires—landing superstars and rising stars alike—and to increase the diversity of our ranks. Today our faculty includes 37 women, an increase of more than 50 percent since 1995. We also added four African American faculty members, up from only one a decade ago. Progress is slow, but I'm confident this trend will continue.

IT's student body is also more diverse and more talented than ever before. We added new degree programs in biomedical engineering, computer engineering, and bio-based products engineering, as well as professional master's programs in software engineering and infrastructure systems engineering. We also worked hard to improve the student experience through better advising and enhanced opportunities from internships to study abroad.

The college has also invested in state-of-the-art classrooms and laboratories. We've built or remodeled several major facilities—the Mechanical



Engineering Building, the George Piercy Wing of Amundson Hall, Walter Library, the Multi-Axial Subassemblage Testing Laboratory, and the Basic Sciences and Biomedical Engineering Building—and laid the groundwork for others, including the renovation of Kolthoff Hall and construction of a new teaching and technology building.

Of course, many of these accomplishments wouldn't have been possible without the generous support of our alumni and friends. Your gifts—nearly $160 million through Campaign Minnesota alone—are an investment in IT's future.

Achieving these goals has been hard work, but I've treasured almost every minute. Along the way I've met thousands of extraordinary people, traveled across the country and around the globe, and discovered a world of new ideas.

I've had the privilege of working for three University presidents whose support helped me—and IT—flourish, even in tough times. I've enjoyed the counsel and camaraderie of my fellow deans, a dedicated group of department heads, and a talented, devoted staff. These relationships—and the friendships I forged with countless faculty, students, and alumni over the years—made my time as dean even more rich and rewarding.

Nine years ago I boldly declared IT the best college at the University of Minnesota. Today, I am even more certain of that fact, and I'm proud to have played a role in shepherding and strengthening this great institution.

It's been an honor and a privilege to serve as your dean. Thank you. ■

Breaking news

Steven L. Crouch is named IT's 15th dean

Crouch, a former civil engineering department head and IT associate dean, took office January 1

STEVEN L. CROUCH, professor of civil engineering and associate dean for finance and planning in the Institute of Technology, has been named the college's new dean. His appointment was announced as this issue of *Inventing Tomorrow* was going to press.

Crouch has strong ties to the University as an alumnus and a faculty member. He received a bachelor of science degree in 1966, and master's and doctoral degrees in mineral engineering (1967 and 1970). He began his career as a research officer with the Chamber of Mines in South Africa from 1968 to 1970, when he joined the Department of Civil Engineering faculty. He served as its department head from 1987 until 1997, when he became the college's associate dean for finance and planning.

CROUCH

Crouch holds the Theodore W. Bennett Chair in Mining Engineering and Rock Mechanics. His main area of interest is numerical modeling of problems in solid mechanics using boundary integral equation methods. His early research dealt with the stability of underground mine openings; more recently, he has become interested in stress analysis techniques for composite materials. In the mid-1970s he developed the displacement continuity method, a widely used numerical tool for solving problems ranging from crack propagation in elastic solids to the design of underground mining excavations.

He succeeds H. Ted Davis, who announced in January 2004 that he would step down after nine years as dean to return to a faculty position after fall semester. A national search for his successor was launched in May.

As dean, Crouch hopes to strengthen the college's interdisciplinary initiatives in digital technology and nanotechnology, and expand its involvement in the University's Initiative for Renewable Energy and the Environment.

"I am honored and delighted to be chosen to carry on the outstanding tradition of the Institute of Technology," says Crouch. "I have had a long and rewarding association with IT, and its continued success is important to me."

You can find out more about IT's new dean in future issues of *Inventing Tomorrow* or online at www.it.umn.edu.

Steven L. Crouch

- Holds Theodore W. Bennett Chair in Mining Engineering and Rock Mechanics
- Earned degrees from the U of M in 1966, 1967, and 1970
- Joined the IT faculty in 1970
- Headed civil engineering department, 1987-1997
- Served as IT associate dean for finance and planning, 1997-2005
- Named dean effective January 1

Two newly dedicated facilities extend the reach of IT research

THE RECENT DEDICATION of two new facilities illustrates the far-flung reach of IT research—from seismic forces deep inside the earth to the far reaches of space.

The new Multi-Axial Subassemblage Testing (MAST) Laboratory—where researchers simulate the effects of earthquakes, windstorms, and other extreme events on materials and structures—celebrated its grand opening September 21 with an event that drew more than 200 people.

MAST is part of the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES), an NSF consortium organized to advance earthquake engineering research

The Large Binocular Telescope Observatory sits atop Mt. Graham

UNIVERSITY OF ARIZONA

and education. Instead of relying on isolated physical experiments, NEES researchers will use integrated physical models, databases, and model-based simulations to improve the design of earthquake-resistant structures, discover ways to retrofit existing structures, and test new materials and construction methods.

MAST can accommodate structures up to 25 feet high and 20 feet wide. Because all NEES facilities are networked, researchers at remote locations can participate in testing and share information in real time. MAST principal investigators include IT faculty from civil engineering, computer science and engineering, and electrical and computer engineering. The lab is funded by a $6.8 million NSF grant and a $4.8 million grant from the University.

In October an international collaboration involving IT researchers celebrated a significant astronomical achievement that opens a new window on space. Researchers and officials from IT, the University of Arizona, and other partner institutions in the U.S. and Europe gathered on Mt. Graham in Arizona to dedicate the Large Binocular Telescope Observatory (LBT). When fully operational in 2005, it will be the most technologically advanced ground-based telescope in the world.


MAST

MAST LABORATORY

The LBT is unlike any other telescope because it utilizes twin 8.4-meter (27.6-foot) "honeycomb" mirrors that sit on a single mount. The telescope is also equipped with adaptive-optics secondary mirrors, which correct in real time the wavefront distortion and image blurring caused by atmospheric turbulence. The LBT produces much sharper images and allows astronomers to see objects deeper in space. Even sharper images can be obtained by combining the light from the two primary mirrors in the "interferometric imaging" mode, which will yield images of faint celestial objects that are ten times sharper than those from the Hubble Space Telescope.

Data collected by the LBT will be used to research the origins of the universe, dark matter, quasars, black holes, and star formation. University astronomers bring expertise in infrared instrumentation to the project.

A $5 million gift from Hubbard Broadcasting funded the University's purchase of a five percent share in the LBT.

Professor's payload survives Genesis crash

WHEN HE LEARNED that NASA's Genesis spacecraft had crashed in the Utah wilderness on September 8, physics professor Robert Pepin felt reasonably confident that his $1 million solar research experiment aboard the capsule had survived the accident. The experiment, a 20-square-inch strip of pure gold foil designed to trap nitrogen particles in the solar wind, had been secured by 26 screws and protected from the impact by items underneath it. Pepin's optimism was vindicated two days later when he learned that the gold foil collector, the mission's second-highest priority for scientific recovery, was undamaged and in excellent condition. According to NASA, the foil is expected to contain more than a million billion atoms of solar wind. About six percent of these are nitrogen atoms.


NASA

During its three-year, $264 million mission into deep space, Genesis collected atoms and ions from the solar wind, a stream of charged particles flowing into space. Scientists say that the surface of the sun, from which the solar wind originates, has preserved the composition of the era when the solar system formed. Researchers will be able to compare the samples' composition with known compositions of the planets, and that data will help in the effort to understand how our solar system and its planets formed.

H. Ted Davis honored with Tekne Lifetime Achievement Award

MORE THAN 1,000 Minnesota business leaders gathered at the Minneapolis Convention Center in November to honor H. Ted Davis, recipient of the 2004 Tekne Lifetime Achievement Award from the Minnesota High Tech Association (MHTA) and Minnesota Technology, Inc. Davis, who served as IT dean from 1995 to 2004, was chosen for his years of innovation and leadership in research and education.


DAVIS

"It's hard to imagine anyone who's influenced more leaders in Minnesota's technology industry than Ted Davis," says MHTA president Kate Rubin, who presented the award.

Established in 2000, the Tekne Awards honor companies and individuals who have shown superior innovation and leadership in technology.

National hypersonics center takes flight

GIVING ASTRONAUTS BETTER TOOLS to prevent and diagnose damage to spacecraft in flight and designing more efficient hypersonic engines are among the research goals at the new National Hypersonics Research Center, based in the Department of Aerospace Engineering and Mechanics. The center is a partnership between the department and Calspan-University of Buffalo Research Center (CUBRC) in Buffalo, New York.

Center researchers want to help prevent accidents like the loss of the space shuttle Columbia, which disintegrated after it encountered intense heat during reentry through the atmosphere. Hot gases entered a hole in the shuttle's left wing, which had sustained damage during launch, and tore the ship apart.

Distinguished McKnight University Professor Graham Candler, the center's principal investigator, is leading the effort to develop equipment that can accurately predict the rate of heat transfer to the shuttle's wing and to reentry spacecraft. Candler is an expert in computer simulations of the flows of air or other gases around vehicles or through vehicle engines moving at supersonic speeds. CUBRC researchers will test Candler's simulations using state-of-the-art wind tunnels to see how accurately the models predict what actually happens.

The two-phase approach develops confidence in the simulations and shows where modeling needs improvement. As a result, modeling can become more reliable and can be used to design more efficient and safer spacecraft, says Candler.

Researchers also intend to design a scramjet engine—a supersonic engine with an inlet that compresses air in the atmosphere and then burns hydrogen to produce thrust. The technology eliminates the need to carry liquid oxygen, which is used to burn rocket fuel.

Scramjet-powered vehicles—capable of flying high, fast, and on short notice—are envisioned as a means of carrying space satellites aloft. The U.S. military is interested in the technology because it could put a satellite into orbit within hours rather than months.

The center was established with a $2 million grant from the U.S. Air Force.


PATRICK O'LEARY

SHORT COURSE

PLAY A ROUND on the Science Museum of Minnesota's (SMM) new mini golf course, and your ball won't just roll around on artificial turf—it will take you on a tour of the whole continent via its own waterway. On the course, called EarthScapes, your ball represents a drop of water, and the game is one big learning experience about what happens to water after it leaves the sky and shapes the earth's surface. Each hole teaches a different science lesson.

For example, Hole 3—the hydraulic jump—features a swift ribbon of water that will sweep your ball into an unruly torrent if you don't putt hard enough against the current. Lesson: Water acts in predictable ways on golf balls, sediment, and anything else.

Hole 8's fairway models the Mississippi River bottom, complete with all sorts of engineered structures to control the flow. Lesson: People have profoundly changed the natural river.

Large interactive exhibits are interspersed with the "golf stream" course. People can play in the tangled channels of sand and water in the braided-stream exhibit, watch what happens when they remove a dam from a model river, or cre-

ate an underwater landslide.

"Of all the common games, golf is the only one that depends entirely on terrain," says geology and geophysics professor Chris Paola, director of the National Center for Earth-surface Dynamics (NCED), which developed EarthScapes. "I hope that someday someone will look down from an airplane and say, 'Ha! There's a braided stream. I saw that in mini golf.'"

EarthScapes is one of several features in the museum's outdoor science park, the Big Back Yard, which opened last summer. Others include the Science House, a building that heats, cools, and powers itself with electricity created from sunlight; the Prairie Maze, where paths wind through plantings of native prairie plants; and a turtle effigy medicinal plant garden.

A synergy of expertise made the Big Back Yard possible. The University and SMM are among the seven institutional partners of the NCED, a remarkable consortium launched in 2002 with a five-year, $19.3 million grant from the National Science Foundation. Headquartered at the University's St. Anthony Falls Laboratory, NCED is an interdisciplinary center where researchers study processes that change the earth's surface over time—everything from sediment mechanics and erosion to braided rivers, rainfall, and climate. The NCED team includes engineers, geologists, ecologists, biologists, chemists, oceanographers, environmental scientists, and experts from other fields.

MORE MINNESOTA-MARS CONNECTIONS

OVER THE PAST 40 YEARS, thousands of photos of the Red Planet's barren, rocky desert have been transmitted to Earth by assorted orbiters, landers, and rovers. NASA's early Mars explorations have given rise to more sophisticated missions like Pathfinder and, most recently, the Mars Exploration Rovers (MER).

But a mission to Mars is never a sure thing: Almost two thirds of all spacecraft destined for Mars have failed in one manner or another before completion. That's why Scott Doudrick (AEM '95, M.S. '97) and Emily Eelkema (AEM '99) were so ecstatic when the first images from MER's Opportunity, the second of its two rovers, came through in January 2004. Doudrick and Eelkema, who work at NASA's Jet Propulsion Laboratory (JPL), played a major role in the development and operation of the MER project.

EDITOR'S NOTE:
In our feature "Minnesota Goes to Mars" (Summer 2004) we overlooked the contributions of two IT alumni who participated in NASA's recent mission. Here is their story.

"We all came in that night to watch Opportunity land," Eelkema says. "It's six minutes of terror between the moment when the spacecraft comes screaming into the Martian atmosphere and when it lands on the planet's surface, and there are so many things that have to happen just right."

The suspense was compounded because the first images didn't come through until a few hours later, but Eelkema says the wait was well worth it.

"All we'd seen [from previous missions] was rocky desert, and the first image from Opportunity was of a smooth plain. It was like nothing we'd ever seen before." The scene back at JPL was bedlam, she says. "The scientists were starting to jump around, and everybody's jaws just dropped. We were the first people ever to see that type of landscape on Mars."

Doudrick spent four years on the MER team as a system engineer. Initially he worked on requirements for flight development of the rovers and later became a cruise-phase technical lead, tracking the rovers from the time they separated from the launch vehicle to the time they reached the atmosphere of Mars.

Doudrick says he knew he wanted to get into aerospace engineering since he was six years old. "I always wanted to do space-related things," he says. "By the time I was in fifth grade, I realized I probably wasn't going to be an astronaut. So I thought, 'Cool, I can build spaceships.'"

Eelkema, a tactical uplink lead, teams with scientists and other uplink engineers to plan the agenda for Spirit and Opportunity. Every set of commands is programmed in sols ("sol" is the term for the Martian day), the commands are sequenced into a form the rovers understand, and that data is then transmitted during the daily communication window with Earth.

Eelkema says she's surprised that the rovers have proven so durable—they were only predicted to last 90 sols. But more than a year since they first landed on Mars, both Spirit and Opportunity are still completely operational. "They did far better than anyone expected," Eelkema says.

Most importantly, the rovers achieved their main objective—to find geological evidence of persistently wet periods in the Red Planet's past. In March 2004, NASA revealed that Opportunity had found evidence that part of the area it was exploring was once covered in liquid water. Spirit later found evidence that rocks at its exploration site had once been wet, too. Such findings suggest the existence of environments that could have been hospitable to life.

NASA (2)

in memoriam

Regents Professor Emeritus **Ernst Eckert**

REGENTS PROFESSOR Emeritus of Mechanical Engineering Ernst R.G. Eckert, internationally renowned pioneer in the fields of heat transfer and thermodynamics, died of heart failure July 8 in St. Paul, two months before his 100th birthday.

A native of Czechoslovakia, he studied at the German Institute of Technology in Prague and worked as a rocket and jet engine scientist at the Aeronautical Research Institute in Braunschweig, Germany, during World War II. He emigrated to the U.S. in 1945 and served as a consultant to the U.S. Air Force and the National Advisory Committee for Aeronautics (NACA).

His interest in teaching and desire to explore a broader range of heat transfer problems attracted Eckert to a career in university research. After his NACA contract expired he accepted an offer to join the University in 1951.

The laboratory he established in the Department of Mechanical Engineering became one of the world's preeminent centers for heat transfer research.

Eckert's 70 years of research and more than 550 papers and books contributed significantly to the field of thermodynamics. He developed the "Eckert Number"—a formula used to calculate high-speed heat transfers. His book *Introduction to the Transfer of Heat and Mass*, published in 1950, is still considered a fundamental text in the field. Later in his career he became interested in researching ways of converting solar energy to electric power.

"He transformed the field of heat transfer from an empirical subject to an engineering science," says Richard Goldstein, a regents professor of mechanical engineering and Eckert's former student.

In 1970 Eckert was elected to the National Academy of Engineering for his contributions to the solution of basic problems in heat and mass transfer. He held seven honorary doctorates and received many other prestigious awards. In 1966 he was one of six faculty to receive the newly created Regents Professorship, the University's highest faculty honor.

FILE PHOTO

Associate Professor **Robert Dexter**

ROBERT DEXTER, a leading expert on steel fatigue and cracking, died November 16 after a sudden battle with acute leukemia. He was 48.

Dexter, an associate professor of civil engineering, was internationally known for his work on fatigue cracking in bridges, buildings, ships, and other structures, and worked as a consultant on scores of projects around the country.

"He was a leading researcher on some of the country's most challenging problems in steel fracture," says civil engineering professor Jerome Hajjar. Dexter's research addressed practical problems faced by structural engineers. His study of wind-induced vibrations in traffic signs, signals, and stadium lights was a basis for national code changes for the design of these structures. His work on steel cracking in ship panels, funded by the U.S. Navy, contributed to a significant change in the design of naval ship welds.

Dexter also served on numerous national and international committees on steel structures. He worked with the Minnesota Department of Transportation and the state bridge engineer's office on several projects, including the Interstate 94 bridge over the St. Croix River near Hudson, Wisconsin, and the Interstate 35E bridge over the Mississippi River in St. Paul.

In addition to his research, Dexter worked closely with students, serving as adviser to the American Society of Civil Engineers student chapter and to the student steel bridge and concrete canoe teams.

Dexter joined the civil engineering department in 1997. He received a bachelor's degree, master's degree, and doctorate in civil engineering from the University of Texas, Austin.

JONATHAN CHAPMAN

Professor Emeritus **Allen Nussbaum**

ALLEN NUSSBAUM, professor emeritus of electrical and computer engineering, died January 5 at age 85. After earning his doctorate in solid-state physics in 1954, Nussbaum spent eight years in industry. He joined the electrical engineering faculty in 1962, specializing in the physics of heterojunctions and PN junctions, and advanced geometrical optics. His work in optics involved the behavior of lenses, mirrors, prisms, and their use in optical instruments such as microscopes, photographic lenses, bar code readers, and medical applications. He served as director of graduate studies for over two decades until his retirement in 1988. Nussbaum published 35 papers and eight books, and served on the editorial boards of *Solid State Electronics* and *IEEE Transactions on Education* and was a Life Fellow of the IEEE. He was a Fulbright Visiting Professor at Hebrew University in Jerusalem (1971–72).

Engineering the

green REVOLUTION

A new major will help the environment and the economy while creating a bright future for its graduates

IN THE DAYS OF PAUL BUNYAN, trees yielded just two main products: wood and paper. Today the state that claims the legendary woodsman is poised to become a leader in the manufacture of new products from trees and other renewable resources. Minnesota's "contender" status got a boost last fall when IT introduced a new undergraduate major, bio-based products engineering.

Students in the new major, called BPE for short, will learn to apply engineering principles to derive "bio-based" products like biodegradable plastics, industrial chemicals, and renewable fuels from plants or other organic matter. As populations grow and resources become scarcer, demand for such products is expected to climb. By launching the program now, IT is preparing graduates who will help shape the industry and the coming revolution in renewables.

The program brings IT into a close working relationship with the College of Natural Resources (CNR) and its bio-based products department (formerly the Department of Wood and Paper Science). Most courses in the curriculum will be taught through the bio-based products department, but the degree will be conferred by IT.

"We wanted to offer potential IT students another engineering option," says Professor Shri Ramaswamy, bio-based products department head. "Students don't usually come to CNR looking for an engineering major."

The BPE major came about largely through the efforts of Ramaswamy and CNR dean Susan Stafford. Ramaswamy sought to revitalize his department's paper science and engineering specialty, a field of study that has suffered in recent years (enrollment in paper engineering programs nationwide has dropped by 50 percent). Meanwhile, oil and gas extraction is decreasing worldwide, crop production is increasing, and the fraction of products obtained from renewables is expected to increase exponentially.

WRITTEN BY
DEANE MORRISON
PHOTOS BY
JONATHAN CHAPMAN

Shri Ramaswamy

Wood supplies more than 90 percent of industrial and consumer products made from renewable resources, and the bio-based products industry hopes to get greater value from wood by extracting energy, chemicals, or materials before pulping and from post-pulping waste.

"In order to do such a comprehensive initiative that involves colleges across the University, you need the support of all the deans," says Ramaswamy. "Susan Stafford was very supportive—we got this done in one year. And Ted Davis's vision for seeing its potential was very helpful." Deans of the College of Agricultural, Food and Environmental Sciences (COAFES) and of the College of Biological Sciences (CBS) also participated in the process.

The paper science major was renamed BPE to reflect its expanded scope and interdisciplinary curriculum. "BPE is really changing the world of wood and forest products," says Stafford. "As I understand, it's the first department of its kind in the world."

The industry needs engineers who know the elements of forestry (the province of CNR), agriculture, and biology as well as engineering. CBS will provide a laboratory course in fermenting sugar to ethanol through its BioTechnology Institute, and COAFES will offer three classes through the Department of Biosystems and Agricultural Engineering.

Besides studying the basic properties of raw materials, BPE majors will learn how to design processes to extract value and to use existing products more efficiently. Examples include the chief constituent of plant fibers, cellulose, which can be broken down into units of glucose and then fermented to ethanol. Plant starch can be converted to plastics, such as the polylactic acid polymers from cornstarch that are made by Cargill Dow. Paper manufacturers can use the wood waste product called "black liquor," which is what remains of wood after the cellulose fiber has been removed. Black liquor can be gasified to make energy, fuels, or chemical feedstocks.

"This can be done with crops as well as trees," Ramaswamy says. "Half of Minnesota has agriculture, and half has forests. Students will learn how to use these resources to make industrial and consumer products. It's timely because forestry and forest products account for $8 billion of the state's gross domestic product, and the governor just announced an initiative to use more ethanol. The big thing is to use renewable resources to make multiple products, not just energy or paper."

James Barsness says the major fits his background and career interests perfectly.

"I grew up in a rural area near Rochester, and I've always had an interest in working with trees," says Barsness, a junior. "Bio-based products give more opportunities to farmers because they can sell to companies. I like BPE because we still learn the traditional uses of wood—paper and lumber—but we're incorporating corn and hemp fiber into paper or using corn and soybeans to make ethanol or bioplastics, for example."

A BPE student uses specialized equipment to test paper strength.

The program's design is intended to ensure that graduates are prepared for careers that match industry needs. Through its industry advisory council, the department maintains close ties to companies like 3M, Andersen Corporation, Blandin Paper, Cargill, Cargill Dow, Georgia Pacific, International Paper, and Potlatch, all of which make bio-based products. Companies like Dow Chemical, DuPont, and Shell Oil are also investing heavily in technologies to make products from renewable resources instead of petroleum, says Ramaswamy.

Ryan O'Connor (ChemE Ph.D. '01), a research engineer at Cargill Dow, endorses the major as the means to give students the knowledge and skills for the jobs at hand. "They'll learn about the engineering and marketing of renewable resources, which fits very well with the vision of Cargill Dow," he says. "Shri [Ramaswamy] has been instrumental in building the new department and major, and he's worked hard to get support from local industry."

GREEN REVOLUTION CONTINUES ON PAGE 31 ▶

After 15 years at the helm of the Department of Chemical Engineering and Materials Science (CEMS), H. Ted Davis was looking forward to a change of pace. The department and its number-one-ranked chemical engineering program had flourished under his leadership, but Davis yearned to return to full-time teaching and research. Two months after leaving his post as head he got a change of pace—albeit not the one he was anticipating—when he accepted an unexpected offer to become the Institute of Technology's 14th dean.

Now, nine years later, Davis has stepped down as dean to fulfill that long-deferred goal and finish his career as professor, a position he calls "the best job at the University." But his agile approach to new challenges, insatiable intellectual curiosity, and drive to get people working together have earned him a permanent place among the University's most accomplished and admired leaders. >>

Peerless LEADER

WRITTEN BY **DEANE MORRISON** | PHOTOS BY **JONATHAN CHAPMAN**

CAROLINA CHEMICAL ENGINEER

The son of an apple farmer and a textile mill worker, Davis grew up near the small town of Hendersonville in western North Carolina. After completing high school, he enrolled at nearby Furman University, expecting to pursue a career in law. But a counselor recognized his skills in math and science and persuaded him to enroll in pre-engineering courses. "Within a month I had fallen in love with the sciences," says Davis. "I never considered a career in law again."

Davis completed a bachelor's degree in chemistry in 1959 and went on to earn a Ph.D. in chemical physics from the University of Chicago in 1962. The following year he interviewed for a position as an assistant professor of chemical engineering at the University of Minnesota.

Davis's agile approach to new challenges, insatiable intellectual curiosity, and drive to get people working together have earned him a place among the U's most accomplished and admired leaders.

"The department head, Neal Amundson, was impressive," recalls Davis. "He was building a young, vigorous, and fast-moving faculty. After that interview, I quit looking. I knew I had found my home."

Davis thrived under Amundson's tutelage and in the company of his colleagues. Over the next two decades he established a reputation as a gifted researcher and dedicated teacher, earning recognition from the University and the broader scientific community.

When he became department head in 1980, Davis built on his predecessors' tradition of hiring bright young faculty members and nurturing them early in their careers. That approach helped make the chemical engineering program the nation's best in rankings released in 1980 and 1993.

Davis's work as department head prepared him well for the challenges he would face as dean, says former University president Ken Keller, who preceded Davis as CEMS department head.

"Ted brought to the deanship all the lessons he'd learned running the best department of chemical engineering and materials science in the country," says Keller, a professor in CEMS and the Humphrey Institute. "He learned how to make decisions that help good people do good things. While some would rather explain why things can't be done, he would rather find ways they can be done."

SUCCESS STORIES

With 400 faculty, 6,500 students, 13 departments, and seven major research centers, IT is no cakewalk to manage—except perhaps to Davis, whom fellow Regents Professor Lanny Schmidt calls "an absolute workaholic." Schmidt, who came to CEMS in 1965, says Davis's embrace of crushing work schedules mirrors his habit of living life in the fast lane. After all, not many academic deans drive a teal blue Corvette. ("I would've bought a red one," Davis explains, "but drivers of red cars get the most tickets.")

Indeed, Davis balanced the mundane aspects of his job with occasional forays into more exhilarating territory, like test-driving student-built race cars. Still, he tackled all of his day-to-day responsibilities with indomitable zeal. Frank Bates, current CEMS department head, can attest to that, and he marvels at the amount of energy the 67-year-old Davis poured into his work.

"In 1999 Ted hired me as department head and told me that being department head wasn't a job—it was a hobby," says Bates. "Well, in my opinion, it's a bit more than a hobby. Now I'm looking forward to being his boss and returning a few favors." Removing tongue from cheek, he adds: "Ted was one of the great department heads in CEMS. As dean he brought a terrific combination of respect for excellence and collegiality to a complicated and diverse faculty in an era when everybody talks about interdisciplinarity but few know what it is."

In IT, interdisciplinarity has meant bringing biology into the equation.

"I believe the 21st century is the century of biology, but the carrier ship is going to be technology," says Davis. "Pushing the biological initiative [begun by former University president Mark Yudof] has been a priority for me."

Davis launched the Department of Biomedical Engineering in 2000 and recruited biology-related faculty to several IT departments. He now hopes to build an internal consortium of nine colleges to make the University a national leader in bioinformatics and computational biology, two fields crucial to sorting the reams of data coming from the Human Genome Project.

Davis also strengthened and expanded the Department of Computer Science and Engineering. Over the years he helped the department add 12 faculty, including some of the country's most promising young computer scientists. He saw an opportunity to further boost the University's computing prowess when Yudof arrived in 1997; together they launched an initiative to help the state recover from the loss of computer giants like Control Data Corporation and Cray. That effort led to the creation of the Digital Technology Center (DTC), 12 more faculty positions across IT, and the $63.4 million renovation and restoration of Walter Library, which now houses both the DTC and the Science and Engineering Library.

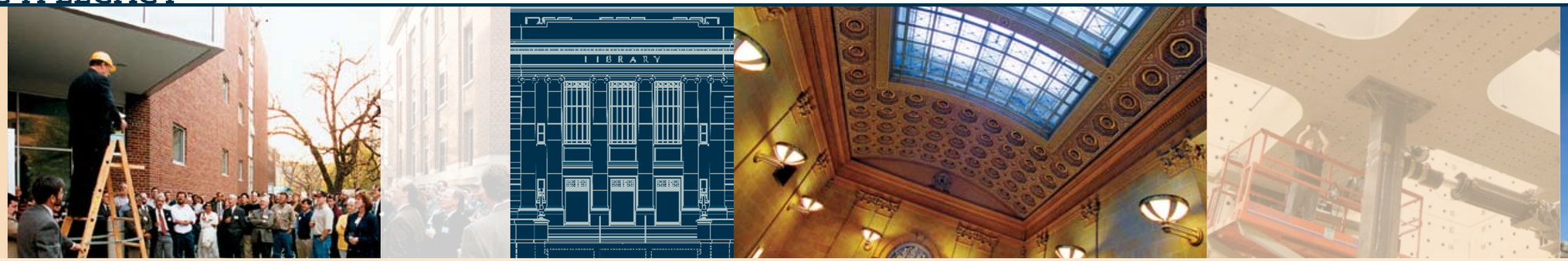
On a broader scale, IT succeeded in landing or retaining four large National Science Foundation centers during Davis's watch, including the Institute for Mathematics and Its Applications, the Materials Re-

FILE PHOTOS

Walter Library's beautifully restored Main Reading Room

BUILDING A LEGACY

Under Davis's leadership, IT added the Piercy Wing to Amundson Hall, completed the stunning restoration of Walter Library, built the MAST laboratory for earthquake research, and upgraded and expanded the Mechanical Engineering Building.



Davis's ability to inspire philanthropic support was key to the success of Campaign Minnesota, which secured $160 million in private contributions to IT between 1996 and 2003. The effort raised $1.6 billion University-wide.

Davis (right), who thrives on teaching and delights in students' achievements, shares a new graduate's joy during IT commencement ceremonies.

search Science and Engineering Center, the National Center for Earth-surface Dynamics, and the Multi-Axial Subassemblage Testing Laboratory.

According to Davis, a successful dean must have both adequate resources and the guts to use them creatively. That means giving department heads the freedom to explore new academic ventures.

Davis made a point of reviewing departments personally, visiting labs and listening to individual faculty members describe their work. He's known not only for his acute interest in their research but also for his ability to understand and discuss it with dead-on accuracy, no matter how far removed from his own expertise the work might be.

"When Ted went to departments or meetings, he couldn't wait to come back and share what he learned," says Peter Hudleston, IT's associate dean for student affairs. "You couldn't help but get caught up in his enthusiasm for new ideas and projects."

HUMOR AND HUMANITY

Davis has been a forceful advocate for IT, but around the dean's office he was known for his gentle demeanor, says his longtime assistant, Connie Galt. "Over the years I've heard him holler up [the chain of command], but I've never heard him holler down."

"He is also a funny, funny guy," says Galt, recounting several practical jokes Davis played on colleagues and friends. Weekly staff meetings in the dean's office were regularly punctuated with outbursts of laughter, she says, often in response to the sly, irreverent wit of the man at the head of the table.

"He doesn't take himself too seriously," adds Karen Wolterstorff, associate to the dean. "He's not just a great faculty member and a great dean, he's a great man."

Everyone who has worked with Davis has a favorite story about his compassionate nature, says IT communications director Paul Sorenson, relating an incident that happened during the renovation of Walter Library.

"One day a young woman came to our temporary offices in tears because her glasses had fallen apart, and one lens had tumbled down the sink drain in the women's restroom," recalls Sorenson. Davis overheard her plea for help as he passed by on his way to lunch and dashed back to his office to grab a wrench. After making sure the restroom was empty, he set to work with Sorenson in tow, crawling under the sink on the grimy tile floor to disassemble the drain and retrieve the lost lens.

"I remember thinking, 'Wow. This is *the dean* spending his lunch hour on the floor of a public restroom digging through the muck in a drainpipe to help a person he's never met before,'" says Sorenson. "But he'd do whatever he could to help someone who needed it. That's just the kind of person he is."

MAN OF THE PEOPLE

A good dean has to like people, says Davis, and it's a part of the job he relished. Whether he's talking to prominent alumni, prospective students, or just ordinary citizens, Davis's casual, approachable manner puts people at ease.

"If you met him on the street you'd think he was just an ordinary guy until you found out how smart he is—and not just about science and engineering. He can talk to anyone about anything," says Wolterstorff. A skilled carpenter, plumber, and cook, Davis also loves music, art, and literature. "And he's fluent in French, too," she adds.

As dean, Davis was a University ambassador at events ranging from government receptions in China to Elks Club meetings in rural Minnesota. He handled them all with aplomb, says John Borowicz (CSci '80), a software designer and former IT Alumni Society president.

"One of my fondest times spent with Ted and his wife, Kathy, was booth duty at the Minnesota State Fair," recalls Borowicz. "We had a great time meeting and greeting fellow Minnesotans and talking up IT. Between the crowd rushes, Ted and I had a terrific afternoon-long chat about everything from falcons and aerodynamics to quantum computing and nanotechnology to new-media protocols and entertainment formats. When our wives would catch an occasional fragment of our hi-tech jabbering, they'd give each other that 'they may be geeks, but they're *our* geeks' look, then laugh."

Adds Borowicz, "The alumni society was thrilled to have Ted as dean. He embraced the notion of closer ties with alumni and strong bonds with industry, both of which are crucial to the future of IT and the University."

Mixing with alumni has always been a special joy for Davis, who often traveled to visit alumni groups around the U.S. "Meeting alumni and seeing their achievements firsthand is a lot of fun. They are great, warm people and great friends of the University," he says.

Alumni are equally excited to see Davis, says IT development officer Jennifer Payne Pogatchnik. When former students hear that he's planning a visit to their area, they even volunteer to pick him up at the airport and chauffeur him during his stay. "It's amazing to me the love his former students have for him," she says.

Davis's ability to strike the right note with people also impresses Lester Krogh (Chemistry Ph.D. '52), a retired senior vice president for research and development at 3M who served on the Dean's Advisory Board.

"I've seen Ted in action as a fundraiser," says Krogh. "He knows how to give information the potential donor wants to hear—how the gift will be used and the benefits." His ability to inspire philanthropic support was key to the success of Campaign Minnesota, which secured $160 million in private contributions to IT between 1996 and 2003.

Davis tirelessly campaigned on behalf of the college, says Pogatchnik, who remembers one successful day in Texas that spanned 14 hours, four donors, and hundreds of miles. The trip—which helped secure more than $200,000 for fellowships—left Pogatchnik exhausted. But Davis, who had talked at length with all the donors about issues important to them, was ready for more.

"He's like the Energizer Bunny. He just keeps going and going and going," Pogatchnik observes.

FILE PHOTOS (2), PATRICK O'LEARY (COMMENCEMENT)

WHAT'S AHEAD

The perpetual motion of his deanship didn't keep Davis, a regents professor and member of the National Academy of Engineering, from practicing his craft. Over the past nine years he continued to advise master's and doctoral students, carving out several hours each week to spend with them.

In September he returned to the classroom to teach a graduate course in the applications of linear algebra and linear operator theory in engineering. He thrives on teaching and prepares meticulously, recognizing that every lecture is nothing less than a performance.

"He was thrilled to get back into the classroom," says Wolterstorff, recalling the first day of classes. "You could see it in his eyes. He just beamed."

PEERLESS LEADER CONTINUES ON PAGE 30 ▶

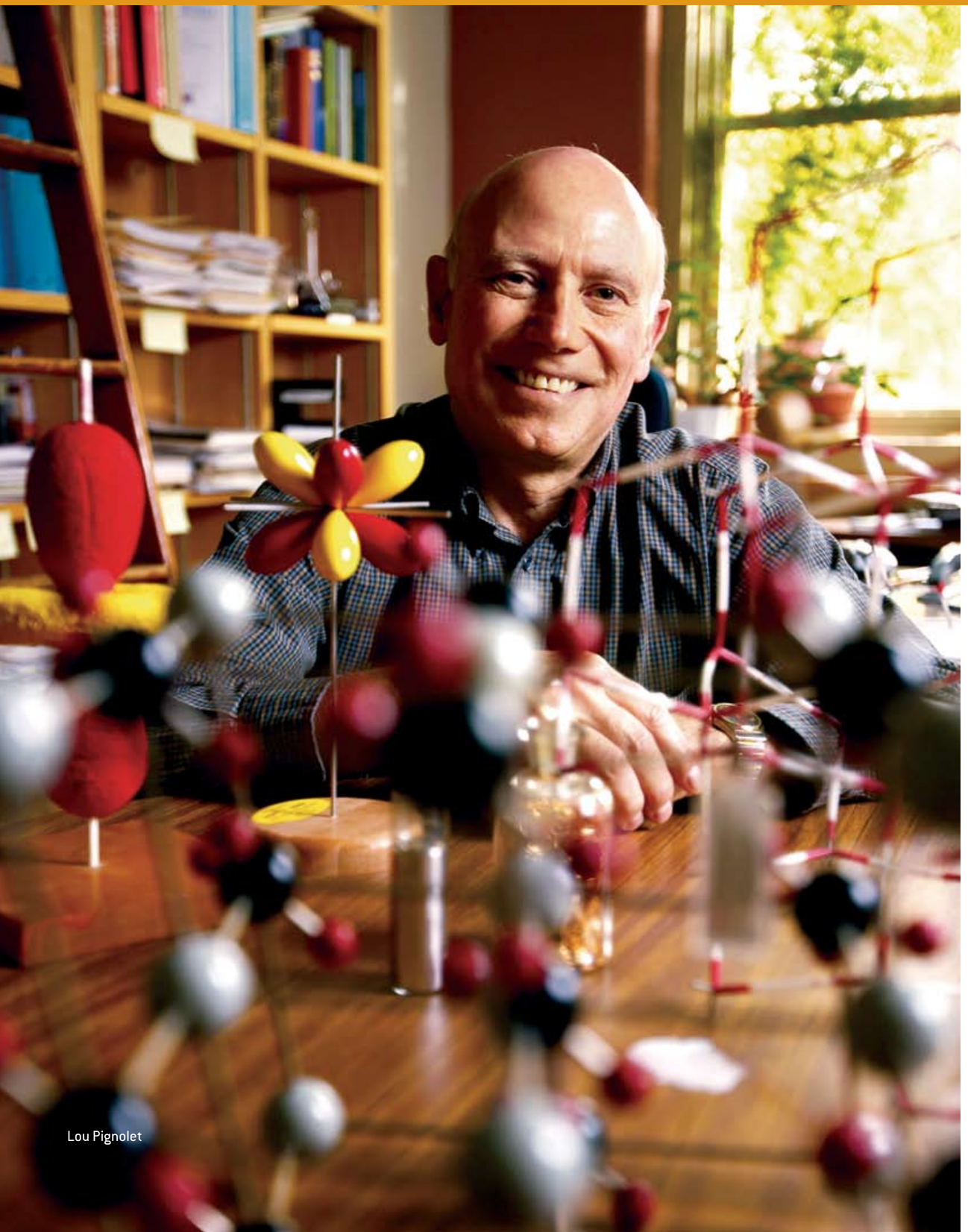
"Ted [makes] decisions that help good people do good things. While some would rather explain why things can't be done, he would rather find ways they can be done."

RENAISSANCE MAN

Certainly Davis loves science and engineering, but he also loves the public art that graces new buildings and takes an active interest in his visual environment. He just finished his second three-year term on the Weisman Art Museum's advisory board, where he worked closely with museum director Lyndel King.

During his tenure as dean, Davis helped sponsor a lecture series that brought together scientists and artists. He took a keen interest in artist Andrew Leicester's *Platonic Figure*, a huge stylized statue next to the Mechanical Engineering Building, and *Cento*, a piece by Harriet Bart that hangs over the information desk on the second floor of Walter Library. *Cento* is a series of glass panels, many marked with symbols of science and engineering. "After the piece was installed, Ted said that every time he walked by he noticed that one formula that should be displayed in it was missing," says King. "He asked us to go back to the artist and have a piece made. She did." Now the formula has taken its rightful place among other symbols of scientific achievement.

"I think he's the kind of person the University needs more of—he sees things broadly, far beyond his own sphere," King adds. "We were lucky to have him at the Weisman."



Lou Pignolet

Here's a look at how some of the best teachers in IT are doing their job

Head OF THE Class

Ask IT alumni about their years at the University, and they'll recount at least one anecdote about a memorable class. But it usually isn't a textbook or syllabus or classroom they remember best, it's the person who stood at the head of the class. Regardless of age or academic discipline, alumni describe with gratitude and awe the professors who guided them over rugged intellectual terrain, encouraged them when the outcome seemed hopeless, and opened the door to worlds they never knew existed. ■ They'll talk about the professor who got them through the rigors of freshman chemistry, another who patiently untangled the complexities of parametric equations, and the one who revealed the indisputably cool realm of nanotechnology. Best of the lot, though, was the academic alchemist who transformed a dreaded requisite course into pure gold—the sheer joy of learning. ■ As a distinguished research institution, the University boasts fine facilities and a vast array of extracurricular opportunities, but all those assets revolve around a central core. Learning is the true heart of the University experience, and great teachers keep that heart beating. >>

WRITTEN BY
JUDY WOODWARD
PHOTOS BY
JONATHAN CHAPMAN

■ LOU PIGNOLET (pictured on page 16) is one of 25 IT faculty in the University's Academy of Distinguished Teachers. Faculty from all campuses are inducted into the academy upon receiving either the Horace T. Morse–University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education or the Award for Outstanding Contributions to Postbaccalaureate, Graduate, and Professional Education.

From frightened freshmen to intensely focused graduate students, everyone in IT experiences the excitement—and relief—of finding a teacher who can make it all seem comprehensible, if not simple. Learners outside academia can share in the college's wealth of fine teachers, too, as anyone who ever attended a performance by the Physics Force can attest.

Great teaching is easy to spot but not as easy to define. Just what makes a great teacher?

For IT undergraduate Sean Welch, the requirements are simple. Great teachers, like his chemistry professor Lou Pignolet, keep him wide awake despite his self-confessed tendency to fall asleep in class. "I learned more than I thought I would [in chemistry], and he is the reason," says Welch.

To sophomore Jia Zou, a great teacher is someone like Assistant Professor Beth Stadler of the electrical and computer engineering department, who gives of her knowledge and herself as a mentor. "Working with Beth one-on-one has been a great experience for me," says Zou. "She has been extremely patient in helping me to get an overview of her field and the basics of what I need to know to get started."

> **"I do more than teach them chemistry. I try to teach a philosophy of studying and how to succeed at the U."**
>
> LOU PIGNOLET

According to Adam Kokotovich, president of the IT Student Board, great teachers know how to challenge and motivate their students. "Their enthusiasm makes the material they teach more fascinating," he says.

"Passion for your discipline, sincere love of working with students, and technical competence" are the hallmarks of great teaching, says Karen Zentner Bacig, coordinator of the University's Academy of Distinguished Teachers. Founded in 1999 to recognize the importance of outstanding teaching, the academy is a "group of highly dedicated faculty who are committed to being a voice in those issues they believe have an impact on the quality of teaching and learning."

However it's defined, good teaching is crucial, says Peter Hudleston, IT associate dean for student affairs and professor of geology and geophysics. "We are a large public research university, but we cannot for long be successful at anything unless we do a good job of educating our undergraduates. The public will not support the University unless it does a good job in the core area of teaching."

Here's a look at how some of the best teachers in IT are doing their job.

Lou Pignolet

Even before the kid took a seat in his office, chemistry professor Lou Pignolet knew what the problem was.

"You can always tell when a guy's doing badly because he has that sheepish, embarrassed look on his face," says Pignolet.

Introductory chemistry classes can be one of life's great watersheds for newly minted University undergraduates, and this young man had been postponing the day of reckoning as long as possible. Finally he'd summoned all his courage and made the fateful trudge to Pignolet's office on the second floor of Smith Hall.

And that's when his prospects for a successful academic career began to improve.

The young man didn't realize it at first, but he'd had a tremendous stroke of good luck when he registered for Pignolet's class, Chemistry 1021.

Pignolet, named a Distinguished Institute of Technology Professor in 1992, is an acknowledged leader in developing interactive, computer-based methods for chemistry education. More importantly, he's an empathetic mentor who measures his success by his ability to help even the most bewildered of incoming freshmen to "get it."

In this case, the stressed-out student spent two hours in Pignolet's office unburdening himself of the tribulations of first-semester life.

"We didn't just talk about chemistry, but [I knew] I could really help this guy," says Pignolet. "I think he left with a good feeling."

It's those moments that provide some of the highlights of Pignolet's professional life. "It's exciting," he says. "I like teaching the freshman course because it's the biggest challenge to reach those students. I do more than teach them chemistry.

Beth Stadler

Randal Barnes

I try to teach a philosophy of studying and how to succeed at the U."

Pignolet takes teaching so seriously that he's devoting the later stages of his career to it.

"About five years ago I closed my lab," he says. "My research was going well, but I decided that I could make more of an impact on students and on our department by [improving] teaching."

Since changing the focus of his work, Pignolet has pioneered computer-based teaching techniques. Before each class, students in his introductory chemistry course take a short online quiz on the reading assignment. A wrong answer launches an immediate online tutorial on the concepts the student failed to understand. Pignolet calls them "carrot quizzes" because they give students the incentive to keep working.

"I look at the quiz results and base my lecture on them. By looking at them I know where to focus the lecture," he explains.

Pignolet also hosts a student-only online bulletin board for course discussions. Most students post questions, but some make a point of helping their classmates understand key concepts. Pignolet keeps track of those Good Samaritans and rewards the most consistently helpful "posters" by taking them out to dinner at semester's end.

The online discussions are wide-ranging indeed. On a recent weekend the most popular discussion thread was entitled "What is love?" Predictably, the first response was "Love is a chemical reaction!" Subsequent postings strayed a bit farther from a strictly scientific point of view, a reminder that first-year college students are at least as interested in each other as they are in the wonders of chemistry.

In the lecture hall Pignolet keeps students engaged and intrigued. He accompanies eye-popping demonstrations with lively off-the-cuff remarks that anchor heady concepts in tangible reality. In a recent class he demonstrated the properties of light waves by setting off a series of chemical combustions with all the panache of a fireworks supervisor on the Fourth of July. He ignited a strontium-filled balloon, triggering a satisfying red flash, and without missing a beat asked, "Did you ever see a glowing dill pickle?"

A fat pickle skewered on two forks and plugged into a 110-volt current transformed the darkened amphitheater into a setting eerily reminiscent of old Frankenstein movies. "Why is it yellow?" called Pignolet over the sound of sizzling salt-laden gherkin. "What element burns yellow?"

His imaginative pedagogy has won Pignolet a shelf full of teaching awards and election to the University's Academy of Distinguished Teachers. The award he's most proud of, though, comes from the undergraduates of IT.

"They've voted me the best teacher in the chemistry department for five years in a row," he says.

Pignolet, who received a Ph.D. from Princeton University in 1969, first realized that he had a talent for teaching back in his undergraduate years at Lafayette College in Pennsylvania. When he took first-year calculus, he remembers, "the professor was confusing the students with his lectures. I was holding alternate lectures at night for my classmates. I developed ways of explaining things that the students could relate to."

That gift for teaching continues to earn Pignolet a place in the memories of students long after they've graduated. Of the young man who finally approached him with his difficulties Pignolet says, "Every year there are two or three students like that. I can work with them. They're the ones who come back years later and say, '[Coming to see you that day] made all the difference.'"

Beth Stadler

When Beth Stadler was an undergraduate at Case Western Reserve University, she got a summer job between her sophomore and junior years working in the lab of one of her professors. Up until then, she says, her experience with lab assignments had been fairly typical.

"When you do a lab assignment, it's supposed to end a certain way, but it never does," she jokes. "You do the assignment and then you spend the rest of the time writing the lab report, explaining why it didn't turn out the way it should have."

That summer job changed things for Stadler. "I found out just why [one] thing worked [in the lab] and why [another] did not. I really enjoyed being the one in the lab, the one in control," she says.

During those few weeks she experienced the thrill of hands-on science and envisioned a future for herself in engineering. She went on to earn a Ph.D. from Massachusetts Institute of Technology in 1994 and then joined the Department of Electrical and Computer Engineering as an assistant professor.

Because that summer job dramatically influenced her career choice, Stadler makes it a professional priority to

■ It's no surprise that a great teacher like RANDAL BARNES is an equally effective advisor to students at all levels. Barnes advises an IT freshman team, participants in the civil engineering department's upper division honors program, and graduate students.

■ Each year more than 400 undergrads receive financial support through the Undergraduate Research Opportunities Program, in which undergraduates assist a faculty member's research or pursue their own projects under faculty supervision. In either case, faculty sponsors like BETH STADLER (pictured on page 19) are key to a successful UROP experience, guiding the student through the research process.

■ One of the most meaningful awards IT faculty can receive comes from their most critical audience—their students. Each year the IT Student Board gives students the chance to cast ballots for best instructor in each department. SERGE RUDAZ is one of several recipients who've made the list more than once.

■ In 2001 MOHAMED-SLIM ALOUINI (pictured on page 24) received a McKnight Land-Grant Professorship, a University-wide career development award given to its most promising junior faculty. IT faculty have received 39 percent of McKnight Land-Grant Professorships since the program began.

introduce young students to the excitement of original research. She participates in the department's on-campus Research Experiences for Undergraduates (REU), a 10-week summer program funded through the National Science Foundation. Undergraduates from four-year institutions that lack research programs are matched with University faculty mentors and learn firsthand what it's like to work in a research lab.

Stadler's also involved in the Undergraduate Research Opportunities Program (UROP), in which University students design and conduct research projects under faculty supervision. Instead of the standard part-time job delivering pizzas or waiting on tables, undergraduates can earn a stipend of up to $1,400 or an expense allowance of up to $300 (or both) while gaining invaluable research experience.

Electrical engineering junior John Reinke is working with Stadler on an element of optical isolator design known as "sputtering thin film magnets." Reinke describes his UROP project as "making a really small magnet" that will ultimately have applications for telecommunications and fiber-optic technology.

Like all researchers, he's learned that not everything goes as planned, and he emphasizes the importance of developing a research plan "way ahead, before you do the hands-on part."

Reinke says the most valuable aspect of the experience—"getting a taste of research"—has helped nudge him toward graduate study. He describes Stadler as being "very open to all my questions."

Stadler herself sees only positives in giving students like Reinke a place in her lab. "It's a preview of the talent," she says. "If they're good, they could end up as your student for grad school."

To foster a sense of independence and responsibility in undergraduate researchers, Stadler normally carves out small individual projects for them that complement a broader goal of her lab.

"Usually I'll give them something we don't really need [to have done], but if it works out, it's a real plus," she says. "The results can make me and my research group look great."

Randal Barnes

If you want to know who the great teachers are, ask the true experts—the students themselves. They may be novices in their academic subjects, but no one is better qualified than a college freshman when it comes to figuring out who can teach in the clearest, most informative manner possible. After all, who has more of an investment in good teaching than a University student, whose future may depend on it and who has at least 12 years of utterly relevant experience?

In the case of civil engineering associate professor Randal Barnes, the verdict is clear. Engineers aren't noted for their use of hyperbole, but in describing their professor, Barnes's students indulge in superlatives more characteristic of marketing majors than future bridge builders.

IT undergrad Jane Delorme is taking Barnes's computer applications course. She says, "I have so many good things to say about Barnes that it is hard to fit them all into one. He is an amazing professor. Everything that I have been taught in his class has been applicable in some shape or form to my other courses."

Her classmate Greg Wachman adds, "[Barnes] makes a huge effort to think like [undergraduates] do. This might mean using a less technical vocabulary when presenting a new concept or approaching a problem from a different angle."

"Barnes does a wonderful job translating complicated math—which he loves—into something manageable for sophomores," says graduate teaching assistant Mindy Erickson. "Math is full of Greek letters and unfamiliar symbols, and he [calls them] by other names, like 'squiggle' and 'pitchfork.' The stress that some students feel when faced with a line full of unfamiliar characters evaporates."

Barnes, who earned a Ph.D. in mining engineering from Colorado School of Mines in 1985, knows exactly what makes a good teacher. "Teaching is a skill that comes with practice," he says. "To do it well you have to want the students to learn, and you must be passionate about the subject. The rest is learned skills."

Over the nearly two decades he's been at the University, Barnes has had plenty of time to hone his teaching skills, and he sometimes surprises his students with what he thinks is important.

There's the matter of writing clearly, for example. In engineering, technical skills are a given, but "writing skills are critical," he says. To engineering undergraduates who may have agonized through creative writing assignments in high school, this news may be an unwelcome shock.

Barnes is quick to reassure them. "We're not talking about how you feel about Virginia Woolf or somebody. Writing, for an engineer, is clarity," he says. "It's never really boring if done right because it's always short."


Serge Rudaz

Mohamed-Slim Alouini

The other skill that Barnes wants to impart is the ability to work in groups. He assigns what he calls "really difficult problems" that practicing civil engineers encounter and then encourages students to seek solutions collaboratively.

"I'll give them a problem they won't be able to do if they don't ask a question," he says. "In the real world, engineering is done in groups, and students need to develop those skills."

Serge Rudaz

A classroom veteran, physics professor Serge Rudaz taught his first classes before many of his current students were even born. He's spent a professional lifetime teaching pure physics to students whose preparation may range from superb to spotty.

"The point of having 20 or 30 years of experience is that you know what's important," he says. "Look at the enormous, thick textbooks that [beginning students] have the misfortune of lugging around. A good teacher can distill that into something a quarter of the size of the text."

Methodical in his preparation and conscientious in his delivery, Rudaz definitely is that kind of teacher. He's also keenly aware of the fearsome reputation that his subject has earned for itself among undergraduates.

"Physics is notoriously difficult," he admits. "It requires so much in the way of background tools."

Over the years Rudaz has developed a repertoire of techniques designed to counter the intimidation factor. For example, he insists on teaching all components of introductory physics sequences so that freshmen don't have to adjust to a new instructor each semester.

To further bolster their confidence, he makes sure that students in his classes receive a solid grounding in the basic laws of physics. Without that foundation, he says, beginning students may regard the subject as "an ad hoc collection of recipes." Sometimes in class he'll rework a single problem just to prove that any of several related approaches—basic Newtonian force laws or the conservation of energy, for example—could be used to solve it.

"The essence of pedagogy is repetition," he says. "I'll provide alternate derivations whether I'm teaching grad students or undergraduates."

He surprises his students with his "old-fashioned approach" to teaching. "I only use chalk and a blackboard. Any other [teaching aids] take away spontaneity," he says. "Attending my lectures is very important. I rarely follow anything in a textbook. If students only read the textbook, they're missing the course."

Rudaz (pronounced Ru-DAH) grew up in French-speaking Canada and received a Ph.D. from Cornell University in 1979. Although it's been several decades since his student days, he remembers clearly his own struggles with physics as an undergraduate and uses these recollections to inspire his teaching.

"I try to put myself in the students' place," he says. "They're bright, they're motivated, but they may have gaps in their background or understanding."

He adds, "Good teaching takes time. I took a job at a research university instead of a research center because I intended to spend half my time teaching. Besides, teaching is a help—not a hindrance—to research. To find the simplest way of looking at things for undergraduates can shape the way you look at research problems."

Mohamed-Slim Alouini

"My class is not very popular," admits Associate Professor Mohamed-Slim Alouini in a forthright assessment of his course on statistical methods in electrical and computer engineering.

From the perspective of many electrical engineering undergraduates, the required course on probability and random processes is "too mathematical." At this phase of their education, they haven't yet witnessed the engineering applications of the principles they're learning in Alouini's class.

"But if they want an accredited degree, they have to take this class," he says, and therein lies the challenge for teacher and students.

Despite his insistence that he's not an exceptional teacher, Alouini's careful preparation, consistently high student evaluations, and multiple teaching awards suggest otherwise. And his style proves that exceptional teaching isn't synonymous with razzle-dazzle classroom pyrotechnics.

Armed with nothing more than a 15-foot whiteboard and colored markers, Alouini rivets the attention of these undergraduates three times a week during an 8 a.m. lecture. At an hour when many of his colleagues are still groping for their first cup of coffee, he's blanketed the whiteboard with mathematical symbols and meticulous notes.

Alouini says that organization is the key to his success as a teacher. Before each lecture he arrives 15 minutes early and fills the right half of the whiteboard with notes grouped neatly into three categories. First he posts administrative announcements, then a

point-by-point summary of the main points covered in the previous class, and finally a list of the coming lecture's important concepts.

"That way, even the students who arrive late see the outline," explains Alouini, who gives credit for the idea to one of his professors at California Institute of Technology, where he earned a Ph.D. in 1998.

However, in a broader sense he's been absorbing pedagogical techniques since childhood. He comes from a family of teachers, including his mother, a retired professor of English in his native Tunisia. Fluent in Arabic, French, and English, Alouini speculates that teaching may just come naturally to him as a result of growing up in his family and of having been a student himself.

> **"I try to treat [the students] as equals in the sense that we're all working together in the course."**
>
> DAVID FOX

"Faculty life is a natural continuation of student life," he says. "Instead of taking exams, now you give exams."

His teaching philosophy dictates a persistent attention to basic concepts and a willingness to intervene when a student's performance begins to lag.

"I try to make sure that everyone in the class gets the basic principles," he says. "That comes from giving many examples in class, sometimes at the cost of not covering more advanced material."

He keeps a running tally of student performance based on quizzes and homework assignments. He orders the teaching assistant in his undergraduate classes to calculate "up-to-now" grades for each student, and before the semester drop-add deadline Alouini personally contacts every student earning less than a C.

"I ask all [of them] to come to talk to me," he says. "I ask them, 'What can we do? Am I going too fast? Should you drop the class?'"

Counseling a student to drop a class isn't always easy, but Alouini would rather deliver a little bad news mid-semester than be forced to award a failing grade at its end.

"I care about what happens to my students," he says simply.

Victor Barocas

In Victor Barocas's biomechanics class, it's almost time to take a vote. The PowerPoint projection on the huge screen in the steeply banked auditorium shows a rudimentary drawing of a stick that's being acted upon by the force of gravity at its center of mass and by a rightward horizontal force at its base.

A few accompanying lines of text summarize the problem, pose the question "What will the stick do?," and submit a menu of possible answers:

A) Rotate clockwise.
B) Rotate counterclockwise.
C) It won't move.
D) You don't have enough information to answer the question.

Barocas, an associate professor in the biomedical engineering department, wanders around the auditorium casually sipping from a soft drink can while listening to the undergraduates' small group discussions. Occasionally Barocas addresses a student by name as he interjects a question or makes a comment that provokes a quiet laugh or two. But now it's time to close the discussion and vote.

"Everyone who thinks the stick will rotate clockwise, raise your hand," he declares.

Proof of Barocas's efficacy as a teacher, the correct answer (B) wins by a landslide and provides a lead-in to the lesson: basic physical principles governing the motion of a patient's upper body in a motorized wheelchair.

Also vindicated is Barocas's deceptively casual instructional style. What seems like an impromptu and unscripted class diversion is actually a carefully thought-out teaching moment.

"I probably take a poll once a

Victor Barocas

David Fox

week," he says. "It may be my favorite way to introduce a new topic. If I just asked the question…no one would respond. But the poll requires only a show of hands, doesn't make a student look dumb by being wrong in front of the entire class, *and* lets the student know that she or he is not the only person in the room who doesn't get it. I find this quite effective."

For Barocas (ChemE Ph.D. '96), who joined the University faculty in 2000, the key to good teaching is a "student-centered approach"—organizing the learning experience in ways that give students confidence in their ability to learn.

"If I can get them to believe in themselves and in the class, they will work harder and pay more attention, and then they will learn," he says.

His students tend to agree. Biomedical engineering junior Santhi Elayaperumal says, "A student in Barocas's class is more likely to perform better…because of his interaction with the students. When there is any sort of personal connection between teacher and students, the students almost always will try to excel in the class."

Barocas tries to shape the classroom experience in ways that maximize opportunities for the sort of personal connections that Elayaperumal admires. He seeks to bridge the sometimes intimidating intellectual distance between student and professor.

"I try to engage the students in nonthreatening ways," he says. "[One] technique is to give the class a fairly simple problem to do and then walk around the class while they do it. The advantage [is] that I speak to individuals, and I find they are much more willing to talk to me about their poor understanding [of the material] one-on-one without having to make the effort to come to my office."

Humor also helps. "I make a lot more jokes in my lecture than most people," he says. "My theory is that if everyone [else] in the room laughs, the kid who isn't paying attention might wonder what's so funny and then start listening to me for a few minutes."

David Fox

David Fox concedes that good teaching and fine acting share a few characteristics, but he draws a careful distinction between the two professions.

"You need to know your lines, project your voice, and have a presence," says Fox, assistant professor of geology and geophysics. "I think teaching is similar to acting, but I don't think good teaching is acting! Being passionate about the subject…and being myself with the students are important components of teaching to me."

Fox should know. Long before he became a distinguished paleontologist with a high-octane lecture style, he was an amateur thespian. "In high school I acted in plays like *Charley's Aunt* and *The Lark*," he says. "In most of [my roles] I couldn't wear my glasses, so I couldn't see the audience. Maybe that was an advantage."

Nowadays, Fox can be found performing—glasses firmly in place—for a different sort of audience. Unlike academics who feel most comfortable behind a lectern, Fox prowls the aisles during his geology lectures, exuding vitality and an enthusiasm that blurs the distinction between teacher and student.

And that's very much by design. "I want to abolish the social hierarchy between me as professor and the students," says Fox, who earned a Ph.D. from the University of Michigan in 1999. "I may know more about the [subject], but I try to treat [the students] as equals in the sense that we're all working together in the course."

To demystify complex topics, Fox relies on his lively sense of humor and knack for creative analogies. He says, "I try to bring unfamiliar concepts to the level of familiarity."

Recently, at the height of mutual political suspicion between America and some of its erstwhile European allies, Fox was lecturing about plate tectonics and continental drift. He pointed out that according to one theory, "the U.S. and Europe are growing further apart." He paused and added impishly, "You could say that statement is true in more ways than one."

He's not above tossing in a pop culture reference—quoting the line "We are stardust" from Joni Mitchell's "Woodstock"—during a discussion about the origins of the universe. He uses a simple but effective comparison to help his students understand isostasy, a fundamental principle of geophysics that explains why postglacial landforms like Hudson Bay are actually growing more shallow.

Picture yourself sitting in a floating inflatable lounge chair in the middle of a swimming pool on a summer afternoon, he tells them. "When you hop out of the chair, it rides higher in the water," he explains, adding that the same process makes the continental lithosphere rise when the weight of a glacial mass is removed through erosion.

As a young academic, Fox dedicated himself to learning the craft of teaching. "I spent a lot of energy and effort developing new courses. It was a conscious decision, but we learn to keep all the balls in the air."

Besides, good teaching creates its own rewards, he believes. "You know when you've 'got' them, and that feels good." ■

■ Real-world learning has a powerful impact, which is why DAVID FOX will spend three weeks next summer teaching introductory field geology to IT sophomores. The class, one of two required hands-on field courses for geology and geophysics majors, is just one example of the experiential learning that IT promotes.

■ A quartet of collegiate honors known familiarly as "the Taylor awards" recognizes outstanding contributions to teaching, service, and research in IT. VICTOR BAROCAS (pictured on page 27) is the 14th recipient of the Taylor Career Development Award, which honors exceptional teachers who are also candidates for tenure.

Honor roll

IT has a wealth of exemplary teachers and advisors. Over the past decade a select group of these individuals, ranging from senior faculty to graduate assistants, have received prestigious awards for exceptional teaching, advising, and mentoring.

University-wide awards

Horace T. Morse–University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education

Established 1965. Recipients are members of Academy of Distinguished Teachers.

Thomas Chase, ME	2003
Kent Mann, Chem	2003
William Durfee, ME	2001
Robert Pepin, Phys	2000
Paul Strykowski, ME	2000
Karl Smith, Civil	1999
Lawrence Rudnick, Astro	1998
E. Calvin Alexander, Jr., Geo	1997
Kenneth Heller, Physics	1997
Gary Gray, Chem	1996
Patrick Starr, ME	1996
Roger Jones*, Phys	1995

Award for Outstanding Contributions to Postbaccalaureate, Graduate, and Professional Education

Established 1998-99. Recipients are members of Academy of Distinguished Teachers.

Mats Heimdahl, CSE	2004
Christian Teyssier, Geo	2003
Peter Carr, Chem	2002
Heinz Stefan, Civil	2001
Lawrence Que, Jr., Chem	2000
Thomas Hoye, Chem	1999
Ephraim Sparrow, ME	1999

John Tate Award for Excellence in Undergraduate Advising

Established 1986.

Ann Pineles, Lower Division	2004
Jane Davidson, ME	2000
Marvin Marshak, Phys	1996

Collegiate awards

George W. Taylor/IT Alumni Society Award for Distinguished Teaching

Established 1982.

Mark Distefano, Chem	2004
Louis Pignolet, Chem	2003
Larry Miller*, Chem	2002
Saifallah Benjaafar, ME	2001
William Durfee, ME	2000
Doreen Leopold, Chem	2000
Paul Strykowski, ME	1999
Ned Mohan, ECE	1998
Kenneth Leopold, Chem	1997
Kent Mann, Chem	1996
Russell Hobbie*, Phys	1995

George W. Taylor Career Development Award

Established 1992 to honor exceptional contributions to teaching by a candidate for tenure.

Victor Barocas, BME	2004
Mohamed-Slim Alouini, ECE	2003
Marc Hillmyer, Chem	2002
Ivan Marusic, AEM	2002
Joseph Konstan, CSE	1999
Prodromos Daoutidis, CEMS	1998
Jerome Hajjar, Civil	1998
Mark Person**, Geo	1997
Victor Reiner, Math	1997
John Riedl, CSE	1996
Yiyuan Zhao, AEM	1996

Charles E. Bowers Faculty Teaching Award

Established 2000.

John Dickey, Astro	2004
James Kakalios, Phys	2003
Thomas Chase, ME	2002
Jerome Hajjar, Civil	2001
Paul Strykowski, ME	2000

John Bowers Excellence in Teaching Assistance Award

Established 2003.

Meghan Kearney, ME	2004
Todd Wittman (Math M.S.'99)	2003

** retired*

*** no longer at U*

FOR MORE INFORMATION see www.it.umn.edu/faculty/awards

PEERLESS LEADER

CONTINUED FROM PAGE 15

As his days in office dwindled, Davis prepared to leave in January for an eight-month sabbatical in Köln, Germany, with Kathy. He's looking forward to spending more time in his laboratory researching the structure of colloids—particles in solution—and how technology can use these structures to make new products such as plastics or "carrying cases" for drugs. He's also interested in the science and engineering of the ultrasmall and counts himself among the 80 or so IT faculty working in the area of nanoscience and nanoengineering.

PATRICK O'LEARY

Ted and Kathy Davis

Reflecting on his years as dean, Davis has no regrets but can't forget some of the inevitable disappointments. Chief among them are the retention cases the college couldn't win because offers from other universities were beyond the University's ability to match.

"In my nine years, we probably lost 10 or 15 faculty I really didn't want to lose. But there have been more saves than losses," says Davis.

Another blue note was sounded last year, when the Minnesota legislature enacted the biggest-ever cut to the University's budget. A major consequence for IT was that teaching assistants and professors had to be spread more thinly.

Looking ahead, Davis hopes the college can address its serious space needs, starting with a new teaching and technology building, currently in the design stage. After its completion he hopes to see renovations and new building assignments that will give every IT unit the space and facilities it needs to excel in teaching and research.

"But first the college must do everything possible to hire and nurture talented people, and the dean must provide strong leadership in this area," says Davis. "Faculty hires and the tenure process are the two most critical processes for the long-term health of the college. The dean must understand that and have the savvy to recognize rising stars and the guts to identify those who don't make the grade."

He offers this parting advice to his successor: "Get to know the IT faculty and department heads, and establish a good working relationship with other deans, heads, faculty, and so on, because it's all about working with people." ■

GREEN REVOLUTION

CONTINUED FROM PAGE 9

O'Connor believes that the switch to renewables is inevitable and that Minnesota is poised to be a hub of bio-refining—the use of biomass or renewable resources for making chemicals, fuels, and materials. "For those who want to stay in Minnesota, there will be lots of opportunities," he predicts.

Another strong endorsement comes from Marlene Mixa (Chemistry Ph.D. '85), chair of the department advisory council's board of directors and a senior research scientist at the North American research center for UPM, one of the world's largest pulp and paper companies.

"The pulp, paper, and allied industries are significant contributors to Minnesota's economic base," says Mixa. "For our industry to survive and thrive, we will continue to need a source of well-educated, qualified people. A degree in bio-based products engineering provides a sound basis for a technically challenging career in an idyllic rural setting."

Approximately 23 students currently are majoring in paper science and engineering. Ramaswamy expects most of them to transfer to IT except the seniors, who most likely would find the switch difficult so late in their college careers.

Of the 12 faculty in bio-based products, about seven or eight will teach BPE courses, giving the new students an enviable faculty-to-student ratio. That could change as more IT students discover the major, although Peter Hudleston, IT's associate dean for student affairs, says enrollment may not take off as rapidly as it has for other new IT degree programs.

"BPE probably won't have the popular allure of biomedical engineering," he says. "Enrollment in that major went from 28 in fall 2000—its first semester—to 250 in fall 2003. Computer engineering began in 1997, also with 28 students, and rose to 222 in its first three years. My guess is that BPE will be more similar to biosystems and agricultural engineering, which has 30 to 40 students." Like BPE, the biosystems and agricultural engineering program offers a degree through IT while being based in a different college (COAFES).

With any new major, "getting the curriculum worked out is always an issue," Hudleston says. "Of BPE, biomedical engineering, and computer engineering, biomedical was probably the most challenging—it involved at least six new courses. Computer engineering required no new ones. Some courses have had to be reworked for BPE, but that was all."

BPE faculty will introduce students to studies in a number of research areas. Professor Simo Sarkanen is working to develop heat-resistant plastics from lignin, a complex polymer that's the chief noncarbohydrate component of wood. Associate Professor Ulrike Tschirner is an expert in making paper with fiber from nonwoody plants, while Associate Professor Steve Severtson is developing environmentally benign pressure-sensitive adhesives for use in products like labels, window envelopes, and stamps. Professor Elmer Schmidt studies how wood rots and how improved preservatives might slow the process, helping wooden structures last longer and thus saving more trees. And Ramaswamy is beginning a project to study how water gets into polylactic acid polymers and hydrolyzes the bonds that hold the molecule together—the key step in its degradation.

The BPE program is designed to prepare graduates for careers that match industry needs.

For students like Barsness, this variety means he'll be prepared for any of the appealing careers that fit his wide range of interests, from bio-based products and bio-fuels to traditional employment in the lumber, paper, or chemical industries.

"I think I'm typical," says Barsness. "I'm open-minded, willing to go anywhere to work in a related field. It's fascinating to be on the cutting edge of these new technologies. As the major becomes more established, I believe it will make students more well-rounded and more attractive to employers."

"I couldn't be more thrilled with this collaboration," adds Stafford. "We wouldn't be successful if we were to go it alone. But working with, for example, people in chemical engineering and materials science, gives us a real competitive edge. Of course, [they] couldn't do it without us, either. We both bring something to the table." ■

FOR MORE INFORMATION see www.cnr.umn.edu/BP

REBUILDING IRAQ

WRITTEN BY
NICHOL NELSON
PHOTOS BY
JONATHAN CHAPMAN

THERE WERE NO PARTY BALLOONS on Craig Johnson's 53rd birthday, nor was there a cake. His entire family was nearly 7,000 miles away, in Plymouth, Minnesota, when Johnson arrived in Kuwait on October 5, 2003. He was headed to Baghdad, Iraq, with a team of engineering consultants charged with a massive task: Find out what needs fixing in Iraq, develop a central list of proposed reconstruction projects, and deliver the plan to the U.S.-led Coalition Provisional Authority and eventually to Congress.

Developing the list was a joint endeavor between Stanley Consultants (Johnson heads the company's Minneapolis office) and Michael Baker Corporation. Their mission was to identify projects and determine their scope, cost, and priority. Of the $87 billion appropriated for the war effort in fall 2003, $18.4 billion was earmarked for reconstruction. Not since the reconstruction of Germany and Japan following World War II had a project of this magnitude been attempted. And as if that weren't pressure enough, Johnson wasn't just part of the team: He was in charge.

Johnson (Civil M.S. '79) knew something about what he was getting into. He'd served as an officer in the U.S. Army Corps of Engineers for four years in the late 1970s and also had traveled to war-torn countries like Uganda and Liberia in similar capacities for Stanley Consultants. "I have an ability to get around town and adapt to the unfamiliar," he says.

Retired rear admiral David Nash, then head of the Program Management Office in Baghdad, had the role of directing the infrastructure reconstruction in Iraq. "Nash wanted people over there in a hurry," Johnson says, and so in September 2003 the process was set in motion.

The Army Corps of Engineers, already in Iraq to assist the reconstruction, had initiated some open-ended contracts for architect-engineer services. "The corps' Transatlantic Programs Center had contracts in place with Baker and Stanley Consultants," says Johnson. "We were each given identical task orders describing what we were going to accomplish together in Iraq."

After receiving the task orders, Johnson's supervisors asked for volunteers. "The company was only looking for people who wanted to go—there was no pressure to volunteer," Johnson says. Reluctance wasn't a factor, however; there were 70 volunteers for the eight spots allotted to Stanley.

The challenges went far beyond the daunting workload. After arriving in Kuwait, the volunteers spent a day undergoing briefings on the security situation in Iraq and being outfitted with standard military-issue equipment (but no weapons). The next morning they boarded a plane bound for the military side of Baghdad's airport. Luckily for Johnson, his group arrived during daylight hours. One contingent of his group wasn't so lucky and had to bed down on the rocks of the tarmac, awaiting dawn and a safe escort to the "Green Zone."

Alumnus Craig Johnson spent six months in Iraq aiding the country's reconstruction efforts

Johnson's group spent its first night in Iraq quartered inside a palace with some soldiers.

"It was surreal," says Johnson. "We were in a beautifully decorated room decked out with murals and chandeliers. It might sound palatial, but keep in mind you're sleeping with 150 of your best buddies—some of whom are world-class snorers."

He remembers walking on the palace grounds and looking at the starry sky while gunfire rounds traced patterns through the blackness. "I can't even describe it," he says.

Because of a temporary housing shortage, the crew slept in seven locations in seven weeks until it was finally given small trailers as quarters. Two people shared each trailer, which boasted a tiny sink and shower. "It wasn't much, but we felt like royalty," Johnson says.

Things weren't much roomier at the office, where the team was trying to compile the list of projects while crammed into a 12-by-20-foot office in the military's headquarters.

Free time was almost nonexistent. The crew worked 11 to 14 hours a day, seven days a week. "I think I worked 174 days and had one day off," Johnson says. "There weren't a lot of golf courses for temptation. But no one complained about the workload. We were part of a great undertaking."

The team worked with Iraq's provisional government to identify projects in six major infrastructure sectors: electricity; security and justice; public works and water resources; transportation and communications; oil; and public buildings, health, and education. Several times a week team members left the Green Zone for meetings with the Iraqi ministry to identify the most urgent reconstruction projects and to calculate their estimated cost. They came up with approximately 5,000 projects, 2,300 of which were recommended for approval. Amazingly, they completed the list less than a month after arriving in Baghdad.

As the work progressed, it was Johnson's job to brief L. Paul Bremer, the U.S. civilian administrator of the Coalition Provisional Authority, about the team's findings. "He's a pretty amazing guy," Johnson says of Bremer, who held the post until the handover of political power to Iraq's provisional government on June 28, 2004. "I spent time with him on several occasions, talking about a variety of different things. He would invite people from various organizations to his residence and mingle with us."

After Bremer's briefing, the list went to all of the major military commanders as well as the local Iraqi governments to inform them about potential projects in their area and to get their response. The list went back to Bremer and then to Washington and the Office of Management and Budget. The finalized report, presented to Congress in early 2004, was accepted.

Greg Thomopulos, president and CEO of Stanley Consultants, says Johnson's role was crucial. "The Iraq reconstruction project needed strong leadership and a project manager with a record of successfully managing high-profile, complex projects. Craig met these requirements, and his past military experience was an added bonus in the environment. We were quite pleased when he agreed to head the team, and his performance far exceeded our client's expectations."

The team's next job was to put together task orders for contractors who were due to arrive in the spring. "Our contract said we were supposed to come up with $2 billion worth of task projects, and before we left we came up with $4 billion," Johnson says. He also partnered with the U.S. government to educate contractors about opportunities in Iraq. Two major events, one in Washington, D.C., and the other in London, publicized the wide array of reconstruction projects. Johnson gave a speech at both gatherings, explaining which sectors needed help.

The work was relentless—Johnson spent six months in Iraq with no break—and the situation became increasingly dangerous because of attacks by the Iraqi insurgency. The rules on base were strict: Anyone leaving the Green Zone—as Johnson's team did while scouting project locations—had to be escorted by armed soldiers.

By the time his crew left Iraq on March 19, 2004, it had created the list of projects, developed the task orders, and seen some of the orders turned into jobs. Johnson expressed disappointment that the degree of resistance in Iraq had slowed progress.

"It's to be expected," he says. "You have to accept the realities of the situation and take solace that you are making a difference."

Now the managing director of joint venture company Stanley Baker Hill, Johnson oversees a company that assists the U.S. government with construction management services in Iraq. "It's the government's job to see that projects are being built correctly in a coordinated manner," he says. "We are accomplishing this work on behalf of the Iraq Project and Contracting Office."

"I think that I achieved what I wanted to do when I volunteered to go—to make a difference in a place that needed a difference very badly."

Johnson holds a medallion (left) commemorating his mission in Iraq. Now back home, he's assisting the U.S. government with construction management services in Iraq and plans to return there for future work.

Upon returning to Minnesota, Johnson experienced mixed emotions.

"It was good to drive along the highway and not have to worry about the [people in the] car next to me and their intentions," he says. "And I appreciated the fact that I was surrounded by people who loved me and who were very concerned with my welfare. I knew that was a fact while I was in Baghdad, but to see it in their eyes was wonderful."

Nevertheless, he missed being involved in the reconstruction efforts, which is why he has agreed to future work in Iraq.

"It's important," he says. "People who knew I was going to Iraq either thought that I was crazy or wished they could go, too. I think that I achieved what I wanted to do when I volunteered to go—to make a difference in a place that needed a difference very badly." ■

The bargain of human potential

Imagine that with a phone call, an email, or the stroke of a pen you had the power to double all the good that a fellowship does.

LIKE MOST BARGAIN HUNTERS, I'm always on the lookout for a good deal. Regardless of the venue—a postholiday department store clearance sale, a flea market, a promising stock, or a supermarket special—I always want to get the most for my money. That's why I get extremely peeved when I've missed out on a bargain just because I failed to follow my best instincts or told myself I'd do it later. As we all know, "later" usually translates to "never," and an opportunity is lost forever.

The same principle applies to charitable giving. Savvy fans of public broadcasting know that during every pledge drive they'll hear about at least one matching challenge that will double the impact of their gift, and they schedule their giving accordingly. It's great to know that by planning well and acting decisively you've done twice as much for an organization or cause that matters deeply to you.

Grateful for the education that launched his rewarding career, Ken Anderson (AEM M.S. '48) was searching for a way to create a meaningful legacy during his lifetime. And when he discovered the perfect opportunity—one that would nurture promising graduate students and help his alma mater—Ken acted without hesitation. In summer 2004, a few months before his death, he established the Kenneth G. and Rosemary R. Anderson Fellowship with a $100,000 gift to the Department of Aerospace Engineering and Mechanics. Ken's gift will be matched by funds from the 21st Century Graduate Fellowship Endowment to create several fellowships.

Established in 2000, this endowment is a result of the University's licensing agreement for the AIDS drug Ziagen with Glaxo Wellcome PLC, a pharmaceutical company. The fund was created with royalties generated by worldwide sales of Ziagen, which was developed at the University by a research team led by pharmacy professor Robert Vince. Gifts of $25,000 or more that are designated to endow graduate fellowships may be eligible for matching through the fund.

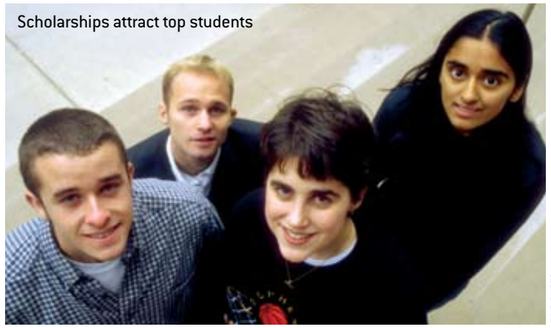
As a former graduate student, Ken understood well the magical mathematics of fellowships. From a student's perspective, they are the factor that multiplies the intellectual rewards of graduate study while reducing its financial burden. At the same time, fellowships increase the University's ability to attract top students, strengthen its intellectual fabric, and carry out its mission as a land-grant institution.

Imagine that with a phone call, an email, or the stroke of a pen you had the power to double all the good that a fellowship does: change a life, spark new ideas, generate breakthrough technologies, or underwrite creative work in a discipline you love. The 21st Century Graduate Fellowship Endowment gives you that power, but time is running out on this extraordinary opportunity. Donors have responded so enthusiastically to this program that the endowment is likely to run short of matching funds early this year.

Maybe you've been thinking about making a gift to IT for a while now, but you've been waiting for the right moment to come along. I hope you will conclude, as Ken Anderson did, that now is the perfect time to invest in human potential—the best bargain you'll ever find.

Before I sign off, I'd like to extend a warm welcome to Tom Burk, the newest member of IT's development team. Tom will be working to strengthen IT's relationships with the corporate community and further develop the Dean's Advisory Board, a group of corporate leaders who counsel the dean on a wide variety of issues. Tom joins us after a long career in the corporate world, including 21 years at Unisys, where his most recent responsibilities included fostering technology transfer with the University. We're excited to have him join IT's development effort. ■

Scholarship drive key to attracting top students to U



Scholarships attract top students

FILE PHOTO

ALUMNI AND FRIENDS have responded generously to the University of Minnesota Scholarship Drive, the historic fundraising effort launched last year by University president Robert Bruininks. The University received $34 million for scholarships from more than 15,000 donors during fiscal 2004, the first year of its ongoing effort to raise $150 million for funding scholarships. The goal of the multiyear drive is to increase by 50 percent the number of students receiving scholarships funded through private gifts.

The drive is the largest effort in University history to raise scholarship funds for students. "I want to make sure that all students with the desire and ability to succeed at the University of Minnesota have the opportunity to do so," said Bruininks, who has made scholarships one of the University's top fundraising priorities.

The number of donors contributing scholarship gifts to the University has more than doubled in the last five years, from 7,200 contributors in 2000 to 15,452 in 2004. Despite that increase, Minnesota lags behind other Big Ten schools and private colleges in the number and size of scholarships it can offer to incoming freshmen. The University offers merit scholarships to only 14 percent of incoming freshmen, placing it last among the Big Ten.

To encourage donors to make endowed scholarship gifts, the University created a new matching fund, the President's Scholarship Match. Through this program the income from new endowed scholarships will be matched by funds from the University, doubling the impact of donors' gifts. The matching program is open to donors making qualified endowment gifts of at least $25,000. Gifts may be made by individuals or groups of individuals, and may be paid over five years. Employer matching funds may be used to reach the $25,000 level.

During the drive's first year, $17 million in scholarship gifts qualified for the matching program.

Our survey says...

THANK YOU to everyone who took the time to complete our alumni survey. We heard from nearly 15,000 alumni—30 percent of you—and learned a great deal about the impressive accomplishments of our graduates. We're busy compiling the data for an updated edition of our 1993 Founders Book. We'll share the details with you in a special report in the next issue of *Inventing Tomorrow*.

IN MEMORIAM: KEN ANDERSON

KEN ANDERSON, whose generous gift to the Department of Aerospace Engineering and Mechanics is noted on the opposite page, died in January. He was 82.

Anderson and his late wife, Rosemary, were ardent supporters of the University and IT. As a young man, Ken became fascinated with airplanes and eventually became an avid pilot. After earning a bachelor's degree from CalTech in 1945, he worked in industry for several years before accepting a position at the University of Minnesota's Rosemount Research Center, where the aeronautical engineering department operated several wind tunnel laboratories. While working and living at Rosemount, Anderson earned his master's degree in aeronautical engineering, graduating in 1948. After leaving the University, he cofounded two companies—Research Inc. and MTS Systems.

ANDERSON

A California native, Anderson was attracted to Minnesota by the University and won over by the state's intellectual and cultural assets. "I told myself I would stay at most a couple of years, but I'm still here," he said in a 1992 interview. "This is the place to be. The Twin Cities and the University, I think, have got everything else beat."

DEVELOPMENT TEAM

IT's experienced professional development officers can help you determine your best options for supporting the college. They can give you information about IT programs with funding needs that match your interests as well as information about ways of giving that best fit your financial situation.

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TO MAKE A GIFT

To support a project you've read about in *Inventing Tomorrow* or to designate a gift for any purpose, you may contact a development officer directly or call 800-587-3884 for more information.

Keep Minnesota's crown jewel shining

I consider the University to be Minnesota's crown jewel, and I believe all of us need to take care of this precious resource.

YOU'D BE RIGHT TO ASSUME that anyone who's serving as IT Alumni Society president has a strong commitment to higher education generally and to the University specifically. When asked why I care so deeply about this institution, I tell a story that begins with my father.

At a time in India when most parents couldn't afford to send their children to school, let alone pay for higher education, my father moved away from his home village to put himself through engineering school. He left because he cherished education and excellence, and he passed those values on to me.

Even as a child I took those values to heart and determined that someday I would go to America and "do science." After receiving an electrical engineering degree in India, I moved to the U.S. and earned a doctorate in electrical engineering from Purdue University.

While on the faculty at the University of Maryland in College Park, I accepted a job offer from Honeywell Systems and Research Center. My colleagues in Maryland had warned me about Minnesota's climate, but I was completely unprepared for the weather conditions on the first day I reported to work. I couldn't see anything through my car's frost-covered rear windshield on August 17, 1977, and when I jokingly protested to my new coworkers, they blithely responded with the Minnesota bromide I've heard every year since: "Oh, don't worry, it's unusually cold this year."

Despite the weather, Minnesota and Honeywell proved to be very warm, friendly places. When Honeywell spun off its defense business to a newly formed company, Alliant Techsystems, I joined Alliant as associate director of research and later went to work for my current employer, Image Sensing Systems.

During my years at Honeywell and Alliant, I witnessed firsthand just how much IT benefits local industry. Both companies recruited many engineers from the University as well as many undergraduate and graduate students, most of them from IT, to work as student aides in our technology areas. The quality of our research and the likelihood of winning competitive research proposals depended on the excellence of our engineers and students, and we were very successful at both endeavors.

I also got to know many IT faculty members and their work. My technology groups collaborated with IT faculty on research projects, and many of our engineers took courses or seminars from IT faculty, either on site or remotely through UNITE Instructional Television.

My family and I have benefited personally from the University. When my son, Robin, was in seventh grade he took advanced math classes through the University of Minnesota Talented Youth Mathematics Program (UMTYMP). He recently graduated from the University with bachelor's degrees in electrical engineering and computer engineering, and now works for Intel. My wife, Fern, received her master's degree in food technology, and my daughter, Nina, is completing two undergraduate majors, in accounting and management information systems.

That's why, for reasons professional and personal, I consider the University to be Minnesota's crown jewel, and I believe all of us need to take care of this precious resource. It's a privilege for me to do my share by providing my leadership within ITAS.

As president, my focus will be on enhancing member services, working with our superb ITAS volunteers, and on strengthening ties between the college, its departments, and our members. All of us must work together to support IT during this time of fiscal austerity to keep our crown jewel shining brightly. ■

ITAS, UMAA honor alumni volunteers

THREE IT Alumni Society members were honored for their contributions at year-end ceremonies held by IT and the U of M Alumni Association. David Hagford (AEM '64) received the inaugural ITAS Outstanding Volunteer Award for his nearly 30 years of service to the ITAS board of directors. Richard Westerlund (EE '60) and Peri Periakurupan (BAE '04) were honored as the UMAA's faculty/staff volunteer of the year and student volunteer of the year, respectively. ITAS also received the UMAA's Program Extraordinaire Award for its creative partnership with FIRST Lego League.

HAGFORD

Help U reverse trend at the Capitol

STRONG STATE SUPPORT of the U of M translates into a strong workforce and improved quality of life for all Minnesotans. In 1974, Minnesota spent eight cents of every dollar on higher education, and today that number is less than four cents. It's time for state leaders to reverse the trend and invest in the U. You can help by joining the Legislative Network, a coalition of alumni, students, faculty, staff, and community members who are committed to educating elected officials and our community about the University's importance to the state. For more information email sbeyer@it.umn.edu or see supporttheU.umn.edu.

JONATHAN CHAPMAN

ITAS offers free day at The Works

THE WORKS, a hands-on science and technology museum for people of all ages, is celebrating its 10th anniversary with a day of fun-filled activities on Saturday, February 26, from 10:00 a.m. to 4:00 p.m. The IT Alumni Society is partnering with The Works to provide free admission to this special event, which also marks National Engineers Week and the 150th anniversary of the first bridge crossing of the Mississippi River.

The whole family can join the challenge of constructing a bridge with raw pasta and testing its strength. Visitors can play a harp with strings of laser light, distort their images with the hilarious Face Warp machine, race a car of their own design timed to the millisecond, and enjoy much more hands-on fun.

The Works is located in the Edina Community Center, 5701 Normandale Road, Edina, Minnesota. For more information call 952-848-4848 or see www.it.umn.edu/alumni/itas/works.html.

This event is made possible through contributions from Edwards and Kelcey, HNTB, Parsons Brinckerhoff, Short Elliott Hendrickson, SRF Consulting Group, URS, and WSB & Associates.

IT ALUMNI SOCIETY

Hundreds of students and mentors packed the ballroom at the Radisson Hotel Metrodome for the IT Mentor Program Kickoff event. Jason Dick (AEM '96), ITAS vice president for student relations, addressed the record crowd. More than 240 students and 170 alumni and friends are participating in the program this year.

IT ALUMNI SOCIETY

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Research takes flight at Rosemount

Purchased from the federal government for one dollar in 1948, the former ordnance works was home to one of the country's finest aeronautical research laboratories.

DURING THE DARK DAYS of World War II the U.S. government acquired by eminent domain 12,000 acres of land in today's bustling suburban Dakota County. The land, located in Rosemount Township, was to be the site of a munitions plant that would support World War II needs, but within a few years 60 percent of the property would be deeded to the University for the modest sum of one dollar.

A spectacular bargain for the people of Minnesota, the sprawling complex has been a major site of University research for more than 50 years. Until the mid-1960s the property was home to one of the country's finest aeronautical research laboratories, and agricultural research continues to be one of its mainstays.

The Rosemount facilities owe their existence to a turbulent era. In 1942 the world was at war, and the federal government moved quickly to provide the U.S. military with munitions needed to win the conflict.

The Rosemount property became the site of the Gopher Ordnance Works, a munitions plant that produced nitrocellulose, a single-base powder used as a high explosive and propellant for large naval guns. DuPont was awarded the construction contract, and groundbreaking began later in 1942. Sixty miles of roads and 33 guard towers were constructed within weeks, and a security force of 500 was hired and equipped with cars and radios so that it could remain in constant contact with nearby Fort Snelling.

Production began in February 1945, and by the end of March, Gopher had more than 3,100 employees, many of whom traveled from around the area to take advantage of the plant's high wages. Rosemount Township had become a booming metropolis seemingly overnight, and as a result, extra police were hired and liquor licenses were limited. County Road 42 ran only eastward in the mornings and westward in the evenings.

When Japan surrendered in August 1945, production at Gopher ceased, and its employees were out of work. By October the last of the powder was packed and readied for shipping. The plant was labeled surplus and dismantled, but only 3,500 acres were sold back to their original owners after the closure.

Aeronautical engineering professor John Akerman played a major role in securing 7,500 acres of the property for the University. Akerman believed that the Rosemount property was an ideal place for an aeronautical research laboratory, and on behalf of the University he initiated negotiations with the federal government to acquire Gopher Ordnance Works. The University took possession of the site in 1948.

With the help of federal grants and use of the powder factory machinery, Akerman developed the Rosemount Aeronautical Research Laboratory (RAL), which would serve as the aeronautical engineering department's primary research facility for almost 15 years. During RAL's first year of operation, the department had research contracts totaling $400,000; by 1954 this figure reached nearly $1 million.

Faculty members designed and installed a number of wind tunnels at Rosemount, including a hypersonic wind tunnel capable of producing speeds between Mach 7 and 11 and air temperatures of 3,000 degrees Fahrenheit. The RAL would be the site of significant research for both industry and the military. Graduates of the department who worked at RAL developed a total temperature sensor for the navy and then formed Rosemount Engineering Company to produce it commercially. Rosemount Engineering became one of the world's largest suppliers of air data and other flow sensors. The company later split into Rosemount Inc. and the Sensor Division of B.F. Goodrich Aerospace.

In 1958 the aeronautical engineering department merged with the Department of Mechanics of Materials. In the post-Sputnik era, research funds were redirected to engineering science-oriented programs. During this time the department's external funding base also changed in favor of projects on the Minneapolis campus. Fewer faculty wished to continue the large aeronautical-based projects required to sustain the lab's extensive facilities and personnel, and reduced funding forced the RAL to close its doors in the mid-1960s.

Now known as University of Minnesota Outreach, Research and Education (UMore) Park, the Rosemount site is a living laboratory located at an active urban/rural interface—a resource for teaching, research, and community education about issues such as land-use history and planning, agriculture, natural resources, health, environment, energy, and water. Nearly 50 University faculty conduct research there.

Amid architectural remnants of the old ordnance plant, signs of new life abound, including an 11-mile riding trail, a truck-driving range for Dakota County Technical College, a law-enforcement bomb detonation area and firing range, and a small airport. The complex is also home to the Dakota County Master Gardeners' Research and Display Garden and a University program that teaches new immigrants about growing and marketing vegetables and flowers for sale in outdoor markets in the Twin Cities area. ■

FOR MORE INFORMATION see umorepark.coafes.umn.edu

UNIVERSITY ARCHIVES (3)

The Rosemount Aeronautical Research Lab attracted research contracts totaling $400,000 during its first year of operation; by 1954 this figure reached nearly $1 million.

Tunnel visionaries

When the University acquired the 7,500-acre property in 1948, it included 55 miles of roads, 26 miles of railroad tracks, nearly 200 buildings, a fully equipped hospital, 25 staff homes, shops of all kinds, a steam plant, and sewage plant. Faculty members designed and installed several wind tunnels at RAL, including a hypersonic tunnel capable of producing speeds between Mach 7 and 11.

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Who's who?

We recently received this 1917 photograph of the engineering faculty from the private collection of an alumnus. Unfortunately, there is no caption for this image, so we're unable to identify many of IT's distinguished faculty forebears in this historic photo. We need your help. If you recognize anyone in this image, call 612-626-7959 or email inventingtomorrow@it.umn.edu with the name and number of the familiar face. Once we learn the names of these early IT scholars, we'll print the details in a future issue.